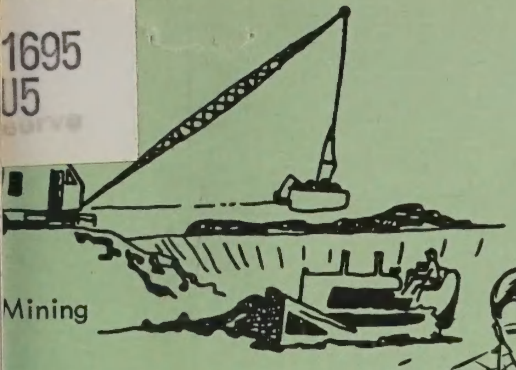

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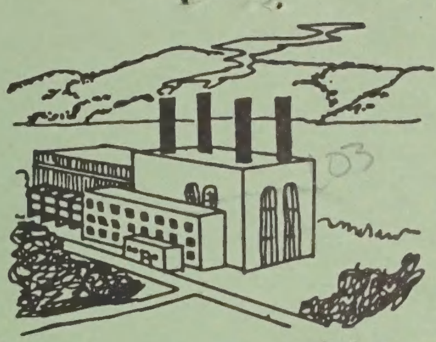

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GREEN RIVER BASIN, WYOMING

COOPERATIVE RIVER BASIN STUDY

MAIN REPORT

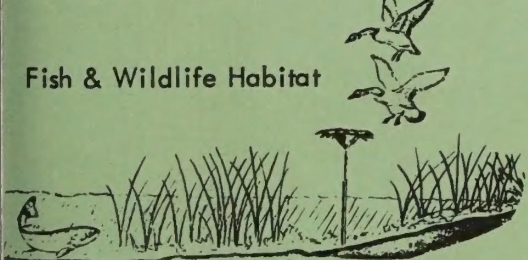
by

UNITED STATES DEPARTMENT OF AGRICULTURE
Economics, Statistics, and Cooperatives Service
Forest Service
Soil Conservation Service

STATE OF WYOMING

September, 1978

Fish & Wildlife Habitat



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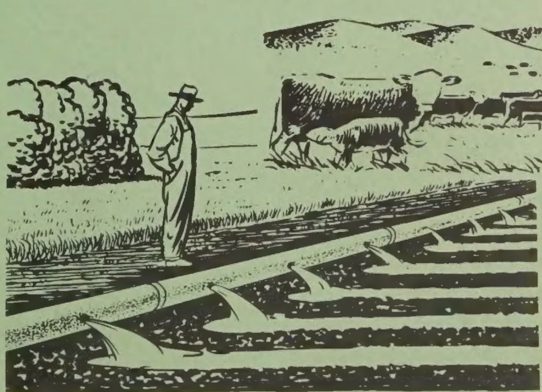

USDA-SCS-PORTLAND, OR. 1978

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PREFACE

PREFACE

This document is designed for use by policymakers and citizens who are interested in the use and conservation of the natural resources of the Green River Basin in Wyoming. The report is the output of a Cooperative River Basin Study. This type of study is a reconnaissance level evaluation of the resource problems and needs for a selected area. Thus, planning alternatives presented are not sufficiently detailed for use in implementing a specific project. As given problems or concerns presented in this report are considered for action, implementation studies for specific project authorization and development will need to be conducted.

This report offers three planning alternatives for alleviating some of the conditions affecting land and water resources of the basin. A variety of measures are presented to protect, enhance and more fully utilize these resources. Implementation of all or any part of a given alternative rests with the residents of the basin and the State of Wyoming.

In order to maintain continuity throughout this report, inventory data and narrative on study procedures not directly related to the development of the planning alternatives are published in the appendices or in USDA Working Papers. This report is organized to allow the reader to follow step by step development of plan elements for each of the specific study objectives. For those readers who are interested in a specific problem or objective, a second "table of contents" is provided. The second "table of contents" shows the location of information by each of the problems or concerns addressed in this study. Each chapter describes a separate step of the plan development process.

Chapter III	The principal problems examined in this study are established.
Chapter IV	Study objectives are quantified to establish levels of resource development, protection and enhancement desired by 1980, 2000, and 2020.
Chapter V	Presents an overview of the resource conditions and use in the basin as it now exists.
Chapter VI	Estimates of the amount of resource development, protection and enhancement that will occur in the future without increased management and planning are presented.
Chapter VII	Lists the level of improvement needed in resource development, protection and enhancement to achieve the desired conditions described in Chapter IV. This level of needs is the difference between the values presented in Chapter IV and VI.

Chapter VIII Alternative plans for fulfilling the needs listed in Chapter VII are presented.

Chapter IX Provides an estimate of the contribution that USDA can make to plan accomplishment and implementation.

Concurrent with the Cooperative River Basin Study, the Department of Interior has also been conducting an investigation of the basin. The Department of Interior's Sublette Investigation, which is in the final report stage, has different objectives than the USDA Cooperative River Basin Study. In order to avoid duplication of effort and expense, the two studies have been coordinated as much as practicable. For example, maps have been printed jointly and there has been a continuing exchange of data to achieve uniformity.

CHAPTER I

SUMMARY

CHAPTER I
SUMMARY

The Wyoming Green River Basin Study was a cooperative federal, state, and local study. Study participants consisted of USDA agencies--Soil Conservation Service; Economics, Statistics and Cooperatives Service; and Forest Service; and the Wyoming State Engineer's Office. Other state and federal agencies, basin residents, and local governmental units also assisted in the study by providing information and suggestions which helped define land and water resource problems and objectives.

The purpose of this study was to define the magnitude of water and land resource problems and to suggest alternative plans for use in facilitating the coordinated and orderly conservation, utilization and management of water and related land resources of the basin. This study did not attempt to identify or quantify all of the land and water resource problems in the basin. It does, however, address important selected problems identified in the rural watershed areas for which USDA has programs for providing technical and monetary assistance toward solutions for all or part of the problem.

Problems

1. Shortage of late season irrigation water on meadow hayland and pasture.

2. Salt loading in the Green River from three major tributaries--the Big Sandy and Blacks Fork Rivers and the Henrys Fork drainage.

3. Inefficient use of irrigation water on irrigated pasture and hayland.

4. Low production and underutilization of wood fiber.

5. Erosion in excess of one-half ton per acre from rangeland and accelerated streambank erosion.

6. Substandard condition and insufficient supply of recreation facilities; particularly campgrounds, wilderness trails, and boating and fishing access to streams.

7. Unused available Colorado River Compact water.

8. Shortage of winter livestock forage.

9. Deterioration of scenic stream corridors and other landscapes.

10. Insufficient identification and management of archeological, fossil and historic resources.

11. Loss or deterioration of fish habitat.

12. Loss or deterioration of wildlife habitat.

Resource Development and Management Needs

The problems listed above are discussed and defined in more detail in Chapter III of this report. It is possible that all or part of these concerns could be solved with current ongoing governmental programs and private efforts. Thus, it was necessary to estimate or project the level of solution that might be forthcoming from current and ongoing efforts (Chapter VI, Projected Future Conditions without the Plan). The remaining unsolved problems or portions of problems were then compared to the resource use and management goals presented in Chapter IV. Chapter VI subtracted from Chapter IV gave the resource management needs (Chapter VII) to be fulfilled by accelerating ongoing programs or initiating new programs (Chapter VIII). Tables I-1 and I-2 summarize the goals, projected future conditions without a plan and the needs for each of the problems.

Planning Alternatives

In accordance with the USDA Procedures for Planning Water and Related Land Resources, two basic planning alternatives for addressing problems were developed. One alternative (A) emphasized national economic development and the other alternative (B) emphasized environmental quality. Thus, these two alternatives provide a range of resource management measures. A third alternative (C) was also developed to emphasize local and regional preferences as well as national economic development and environmental quality.

Each of the alternatives is an aggregation of plan elements for solving the need or problem. These plans were developed to assist the basin residents, local units of government, and State of Wyoming in determining the direction and policies they may want to implement in managing water and land resources in the Green River Basin.

Table I-3 displays the capability of planning alternatives to satisfy year 2000 needs. Table I-4 displays the summary of planning alternative effects. Table I-5 shows the capability of USDA programs to assist in the implementation of Planning Alternative C and to satisfy needs for the year 2000.

Implementation

Three planning alternatives for the use and management of the water and land resources in the Green River Basin are presented in this study. It is up to basin residents and the State of Wyoming to decide which, if any, of these planning alternatives will be used in the management of the basin's resources. It may be that only portions of a planning alternative or a different emphasis would be more desirable, particularly as unforeseen conditions arise.

Various groups and organizations will have more interest in certain parts of alternatives than in others. An individual organization or combination of organizations may want to sponsor individual plan elements. Sponsoring organizations should enlist the support of other groups, local governmental agencies, conservation districts, and state agencies to implement individual plan elements. Local, state and federal agencies can assist in funding of projects and act to coordinate the implementation process.

Table I-1 National economic development objective needs by time frame, Green River Basin, Wyoming

Specific study objectives	Units	Total desired goal	1980 Desired goal	1980 Projected future without plan	1980 Needs	2000 1/ Desired goal	2000 1/ Projected future without plan	2000 1/ Needs	2020 1/ Desired goal	2020 1/ Projected future without plan	2020 1/ Needs
1. Improved irrigation water supplies for late season use.	Acres	60,700	60,700	2,600 6/	58,100	60,700	2,600	58,100	60,700	2,600	58,100
2. Reduce salt loading of the Green River from the Big Sandy and Blacks Fork Rivers and Henrys Fork.	Watersheds	3	0	0	3	3	0	3	3	0	3
3. Improved irrigation water use efficiency.	Acres	205,200 2/	60,500	48,000	12,500	140,500	88,000	52,500	205,200	128,000	77,200
4. Increase annual utilization of fuelwood and small wood products.	Cords (Ea.)	3,370	2,780	2,440	340	3,370	1,200	2,170	3,370	1,200	2,170
	Posts (Ea.)	14,150	11,840	10,070	1,770	14,150	12,500	1,650	14,150	12,500	1,650
	Poles (Ea.)	74,450	72,160	64,870	7,290	74,450	66,100	8,350	74,450	66,100	8,350
5. Increase annual roundwood: production	MM.cu.ft.	21.7	14.6	12.5	2.1	21.7	16.6	5.1	21.7	17.8	3.9
harvest 3/	MM.cu.ft.	21.7	14.6	5.3	9.3	21.7	3.0	18.7	21.7	3.0	18.7
6. Reduce erosion on rangeland to a rate below 0.5 tons/ac./yr.	Acres (thousands)	11,685.8	9.000.0	8,747.0	252.3	10,000.0	8,973.7	1,026.3	11,685.8	9,199.7	2,486.1
7. Improve management of the present recreation activity opportunities and recreation facility maintenance.	Dollars (thousands annually)	2,982.4	1,548.6	937.4	611.2	2,200.7	1,558.6	642.1	2,982.4	2,378.9	603.5
8. Increase recreation facilities.											
Boat launching	Sites (no.)	36	12	11	1	23	15	8	36	20	16
Picnic grounds	Sites (no.)	147	47	29	18	114	35	79	147	43	104
Campgrounds	Sites (no.)	71	42	40	2	55	48	7	71	56	15
Fishing-miles of stream with access	Stream miles	2,953 4/	2,441	2,391	50	2,953	2,391	562	2,953	2,391	562
9. Utilize available Colorado River Compact water.	Acre-feet (annually)	805,000 5/	805,000	455,100	349,900	805,000	571,300	233,700	805,000	616,800	188,200
10. Increase production of winter livestock forage.	AUMs (annually)	749,790	262,460	262,460	0	650,175	550,175	100,000	749,790	649,790	100,000

1/ Quantities indicated include previous time frame amounts.
2/ Represents total acres on which it is feasible to improve efficiency.
3/ Pole and fuelwood quantities are included.
4/ Represents total fishing stream miles in basin.
5/ Represents minimum water available to Wyoming under the Colorado River Compact as estimated by the Department of Intérior. Available for new uses: 188,200 acre-feet after accounting for projected commitments through 2020.
6/ Assumed satisfied by Savery-Pothook Project.

Table I-2 Environmental quality objective needs by time frame, Green River Basin, Wyoming

Specific study objectives	Units	Total desired goal	1980 Desired goal	1980 Projected future without plan	1980 Needs	2000 1/ Desired goal	2000 1/ Projected future without plan	2000 1/ Needs	2020 1/ Desired goal	2020 1/ Projected future without plan	2020 1/ Needs
1. Protect and enhance scenic stream corridors.	Protected miles of stream corridor	3,178	1,426	1,386	120	2,788	1,618	1,170	3,178	1,929	1,249
2. Reduce concentrated use in local areas within wilderness management units.	Management units properly managed	11	11	2	9	11	2	9	11	2	9
3. Identify and protect significant archeological and fossil areas.											
Archeological	Acres reconned	424,000	80,000	80,000	0	424,000	80,000	344,000	424,000	80,000	344,000
Fossil	Acres reconned	9,430,000	2,209,000	2,009,000	200,000	6,578,500	3,000,000	3,578,500	9,430,000	3,000,000	6,430,000
4. Preserve and protect historical sites.	Sites adequately protected	127	50	14	36	127	14	113	127	14	113
5. Reduce erosion on rangeland to a rate below 0.5 tons/ac./yr.	Acres	11,685,800	9,000,000	8,747,000	252,300	10,000,000	8,973,700	1,026,300	11,685,800	9,199,700	2,486,100
6. Reduce streambank erosion.	Stream miles	200	19	0	19	200	0	200	200	0	200
7. Provide minimum flows for a viable fishery on certain streams.	Stream miles	188	70	0	70	188	0	188	188	0	188
8. Maintain fishing stream quality.	Stream miles	1,460	584	0	584	1,460	0	1,460	1,460	0	1,460
9. Create and enhance waterfowl habitat.											
Create	Acres	7,800	7,800	0	7,800	7,800	0	7,800	7,800	0	7,800
Enhance	Acres	19,000	19,000	0	19,000	19,000	0	19,000	19,000	0	19,000
10. Enhance and protect critical wildlife winter habitat for:											
Antelope	Acres	1,762,000	1,762,000	1,126,500	635,500	1,762,000	1,260,300	501,700	1,762,000	1,394,000	368,000
Mule deer	Acres	1,030,000	1,030,000	384,000	646,000	1,030,000	520,000	510,000	1,030,000	656,000	374,000
Elk	Acres	766,000	766,000	547,780	218,300	766,000	594,700	171,300	766,000	641,600	124,400
Moose	Acres	328,000	328,000	234,900	93,000	328,000	254,500	73,500	328,000	274,100	53,900
11. Utilize available Colorado River Compact water.	Acre-feet (annually)	805,000 2/	805,000	455,100	349,900	805,000	571,300	233,700	805,000	616,800	188,200

1/ Quantities indicated include previous time frame amounts.
2/ Represents minimum water available to Wyoming under the Colorado River Compact as estimated by the Department of Interior. Available for new uses: 188,200 acre-feet after accounting for projected commitments through 2020.

Table I-3 Capability of planning alternatives to satisfy year 2000 needs, Green River Basin, Wyoming

Specific study objectives	Unit of measure	Year 2000 total need 1/	Alternative A (NED)		Alternative B (EQ)		Alternative C	
			Needs satisfied	Remaining needs	Needs satisfied	Remaining needs	Needs satisfied	Remaining needs
1. Improve irrigation water supplies for late season use.	Acres	58,100	30,400	27,700	0	58,100	48,200	9,900
2. Reduce salt loading to the Green River from the Big Sandy and Blacks Forks Rivers and Henrys Fork.	Watershed	3	3	0	0	3	0	3
3. Improve irrigation water use efficiency.	Acres	52,500	52,500 2/	0	0	52,500	48,200 2/	4,300
4. Increase the utilization of fuelwood and small wood products annually.	Cords (each)	2,170	2,170	0	0	2,170	2,170	0
	Posts (each)	1,650	1,650	0	0	1,650	1,650	0
	Poles (each)	8,350	8,350	0	0	8,350	8,350	0
5. Increase annual roundwood: production	MMcu.ft.	5.1	5.1	0	0	5.1	5.1	0
harvest	MMcu.ft.	18.7	18.7	0	0	18.7	7.4	11.3
6. Reduce erosion on rangeland.	Acres with erosion rate below 0.5 ton/ac./yr. (thousands)	1,026.3	1,026.3	0	1,026.3	0	513	513
7. Improve management of the present recreation activity opportunities and recreation facility maintenance program.	Dollars (annually)	642,100	642,100	0	0	642,100	642,100	0
8. Increase recreation facilities. Boat launching sites	Sites (no.)	8	8	0	0	8	8	0
Picnic grounds	Sites (no.)	79	79	0	0	79	79	0
Campgrounds	Sites (no.)	7	7	0	0	7	7	0
Fishing-streams with access	Stream miles	562	140	422	0	562	562	0
9. Utilize available Colorado River Compact water in basin.	Acre-feet (annually)	188,200 3/	29,900 4/	158,300	20,000	168,200	188,200	0
10. Increase production of winter livestock forage.	AUMs (annually)	100,000	100,000 5/	0	0	100,000	100,000 5/	0
11. Protect and enhance scenic stream corridors.	Protected miles of stream corridor	1,170	0	1,170	1,170	0	800	370
12. Reduce concentrated use in local areas within wilderness management units.	Number of properly managed wilderness mgmt. units	9	0	9	9	0	9	0
13. Identify and protect significant archeologic and fossil areas.	Acres reconned archeological	344,000	0	344,000	344,000	0	72,000	172,000
	fossil	3,578,500	0	3,578,500	3,578,500	0	1,789,000	1,789,000
14. Preserve and improve historical sites.	Sites adequately protected	113	0	113	113	0	90	23
15. Reduce streambank erosion.	Miles of stream	200	0	200	200	0	100	100
16. Provide minimum flows for a viable fishery on certain streams.	Miles of stream	188	0	188	188	0	174	14
17. Maintain fishing stream quality.	Miles of stream	1,460	0	1,460	1,460	0	1,460	0
18. Enhance and create waterfowl habitat.	Acres - enhanced	19,000	0	19,000	4,800	14,200	4,800	14,200
	created	7,800	0	7,800	7,800	0	7,800	0
19. Enhance and protect critical winter habitat for selected resident wildlife species.	Antelope (acres)	501,700	0	501,700	501,700	0	251,000	250,700
	Mule deer (acres)	510,000	0	510,000	510,000	0	255,000	255,000
	Elk (acres)	171,300	171,300	0	171,300	0	171,300	0
	Moose (acres)	73,500	0	73,500	73,500	0	73,500	0

1/ Year 2000 need includes 1980 time frame need.
2/ Needs satisfied by plan elements for specific Study Objectives 1 and 2. Objective 2 improves efficiency on 43,600 acres.
3/ Need figure occurring here is for the year 2020.
4/ Includes agricultural and potential industrial water.
5/ Needs satisfied by plan elements for specific Study Objectives 1, 2, 3 and 6 exceed 100,000 AUMs.

Table I-4 Summary of planning alternative effects for year 2000, Green River Basin, Wyoming

Accounts	Unit	Plan A (NED)	Plan B (EQ)	Plan C
A. ECONOMIC DEVELOPMENT				
1. Plan elements evaluated for benefits and costs				
a. Beneficial effects	Av. Ann. $	13,560,300	--	15,278,500 1/
b. Adverse effects	Av. Ann. $	11,915,600	--	8,961,800
c. Net beneficial effects	Av. Ann. $	+ 1,644,700	--	+6,316,700 1/
2. Plan elements evaluated for costs only				
a. Beneficial effects - not evaluated in monetary terms, benefits assumed at least equal to costs	—	--	--	--
b. Adverse effects	Av. Ann. $	2,809,600	3,627,900	2,005,700
B. ENVIRONMENTAL QUALITY (Beneficial and adverse effects)				
1. Areas of natural beauty				
a. Change rangeland and forest land to recreation facilities.	Acres	161	0	245
b. Improve recreation site aesthetics.	Yes or No	Yes	No	Yes
c. Preserve and enhance scenic stream corridors.	Miles	0	1,660	2,360
d. Decrease visual quality by increasing activity on commercial forest land.	Yes or No	Yes	No	Yes
e. Improve visual quality on rangeland.	Acres	1,026,300	1,026,300	513,000
2. Quality consideration of water, land, and air resources.				
a. Improve water quality by decreasing TDS (amount undetermined), and nutrients entering the Green River and reservoirs.	Yes or No	Yes	No	Yes
b. Increase forage production.	AUMs	203,600	20,500	198,300
c. Improve irrigation efficiency.	Acres	101,700	0	48,200
d. Reduce soil erosion on rangeland, roads and trails.	Acres	1,026,300	1,026,300	513,000
e. Increase human activity on recreation areas.	Yes or No	Yes	No	Yes
f. Increase human activity on new accessible streams.	Miles	140	0	562
g. Reduce erosion and sedimentation on streams.	Miles	0	200	100
h. Increase erosion and sediment during construction and logging.	Yes or No	Yes	Yes	Yes
i. Reduce Green River water discharge to Colorado River.	Yes or No	Yes	No	Yes
j. Increase human activities on commercial forest land.	Yes or No	Yes	No	Yes
k. Improve fish management on streams.	Yes or No	Yes	Yes	Yes
l. Decrease forest fire, disease, and insect hazards.	Yes or No	Yes	No	Yes
m. Harvest timber in wilderness study and roadless areas.	Yes or No	Yes	No	Yes
n. Reduce use concentration in wilderness area from people and livestock.	Management unit	0	9	9
3. Biological resources and selected ecosystems				
a. Increase open water wetlands.	Acres	635	957	1,883
b. Inundate perennial streams.	Miles	3	14	8
c. Inundate terrestrial wildlife habitat.	Acres	635	5,957	6,883
d. Decrease phreatophytes and associated wildlife along streams.	Yes or No	Yes	No	Yes
e. Reduce streamflow fluctuations.	Yes or No	Yes	Yes	Yes
f. Improve channel crossing for livestock and wildlife.	Yes or No	No	Yes	Yes
g. Preserve fishing stream habitat.	Miles	0	1,460	1,460
h. Create waterfowl breeding habitat.	Acres	0	7,800	7,800
i. Enhance waterfowl breeding habitat.	Acres	0	4,800	4,800
j. Improve critical winter habitat for big game animals.				
1. Antelope	Acres	0	501,700	251,000
2. Mule Deer	Acres	0	510,000	255,000
3. Elk	Acres	0	171,300	171,300
4. Moose	Acres	0	73,500	73,500
k. Reduce waterfowl habitat associated with cropland.	Ac. of cropland	101,700	0	58,100
4. Irreversible or irretrievable commitment of resources				
a. Commit rangeland and forest land to recreation areas.	Acres	161	0	245
b. Commit perennial stream to reservoir.	Miles	3	14	8
c. Commit Colorado River Compact water to various uses.	Acre-feet	29,900	20,000	188,200
d. Consume fossil fuels during construction.	Yes or No	Yes	Yes	Yes
C. SOCIAL WELL-BEING (Beneficial and adverse effects)				
1. Create temporary jobs during installation of structures and land treatment.	Jobs	504	738	1,059
2. Create permanent jobs.	Jobs	585	7	135
3. Create seasonal jobs.	Jobs	97	10	114
4. Improve ranch unit stability.	Yes or No	Yes	No	Yes
5. Improve recreation experience for visitors.	Yes or No	Yes	No	Yes
6. Utilize Colorado River Compact water in Wyoming.	Acre-feet	29,900	20,000	188,200
7. Reduce landowner rights along streams.	Acres	0	91,800	91,800
8. Improve overall hunting quality.	Yes or No	No	Yes	Yes
9. Increase hunting opportunities.	Yes or No	No	Yes	Yes
10. Improve fishing quality.	Yes or No	No	Yes	Yes
11. Increase fishing opportunities.	Yes or No	Yes	No	Yes
12. Discover, protect or enhance archeological resources.	Acres	0	344,000	172,000
13. Discover, protect or enhance fossil resources.	Acres	0	3,578,500	1,789,000
14. Discover, protect or enhance historical resources.	Sites	0	113	90
15. Harvest renewable wood fiber resources on commercial forest land	Yes or No	Yes	No	Yes
16. Increase human activities on water area and associated land.	Acres	735	9,100	10,575
17. Increase or improve accessibility to commercial forest land.	Yes or No	Yes	No	Yes
18. Decrease number of visitors at certain times, limit choice of areas and limit motor vehicle use.	Yes or No	No	Yes	Yes
19. Decrease livestock grazing on critical winter range for wildlife.	Acres	0	1,256,500	750,800
20. Reduce future opportunities to appropriate water for agriculture.	Yes or No	No	Yes	Yes
21. Reduce real estate taxes to landowners.	Yes or No	No	Yes	Yes
22. Reduce tax revenue to local governments.	Yes or No	No	Yes	Yes
23. Provide more flexibility for meeting Colorado River Compact water commitments.	Yes or No	No	No	Yes
24. Protect natural resources for future generations.	Yes or No	No	Yes	Yes

1/ Includes direct and external benefits. See definitions of these benefits on individual display sheets for specific study

Table I-5 Capability of current USDA programs to assist in the implementation of alternative C and satisfy needs for year 2000, Green River Basin, Wyoming

Specific study objectives	Unit of measure	Year 2000 total need 1/	Needs satisfied by alternative C	Potential USDA portion of alternative C	Alternative C minus USDA portion	Total need minus USDA portion = total remaining need
1. Improve irrigation water supplies for late season use.	Acres	58,100	48,200	4,000	44,200	54,100
2. Reduce salt loading to the Green River from the Big Sandy and Blacks Forks Rivers and Henrys Fork.	Watershed	3	0	--	--	3
3. Improve irrigation water use efficiency.	Acres	52,500	48,200 2/	13,900	34,300	38,600
4. Increase the utilization of fuelwood and small wood products annually.	Cords (each)	2,170	2,170	2,170	0	0
	Posts (each)	1,650	1,650	1,650	0	0
	Poles (each)	8,350	8,350	8,350	0	0
5. Increase roundwood: production	MMcu.ft.	5.1	5.1	5.1	0	0
harvest	MMcu.ft.	18.7	7.4	7.4	0	11.3
6. Reduce erosion on rangeland.	Acres with erosion rate below 0.5 ton/ac./yr (thousands)	1,026.3	513.0	513.0	0	513.0
7. Improve management of the present recreation activity opportunities and recreation facility maintenance program.	Dollars (annually)	642,100	642,100	449,000	193,100	193,100
8. Increase recreation facilities						
Boat launching	Sites (no.)	8	8	4	4	4
Picnic grounds	Sites (no.)	79	79	8	71	71
Campgrounds	Sites (no.)	7	7	5	2	2
Fishing – miles of streams with access	Stream miles	562	562	0	562	562
9. Utilize available Colorado River Compact water in basin.	Acre-ft. (annually)	188,200 3/	188,200	29,900	158,300	158,300
10. Increase production of winter livestock forage.	AUMs (annually)	100,000	100,000 4/	15,600	84,400	84,400
11. Protect and enhance scenic stream corridors.	Protected miles of stream corridor	1,170	800	0	800	1,170
12. Reduce concentrated use in local areas within wilderness management units.	Number of properly managed wilderness management units	9	9	9	0	0
13. Identify and protect significant archeologic and fossil areas.	Acres reconned archeological	344,000	172,000	172,000	0	172,000
	fossil	3,578,500	1,789,000	0	1,789,000	3,578,500
14. Preserve historical sites.	Sites adequately protected	113	90	0	90	113
15. Reduce streambank erosion.	Miles of stream	200	100	50	50	150
16. Provide minimum flows for a viable fishery on certain streams.	Miles of stream	188	174	0	174	188
17. Maintain fishing stream quality.	Miles of stream	1,460	1,460	0	1,460	1,460
18. Enhance and create waterfowl habitat.	Acres – enhanced	19,000	4,800	0	4,800	19,000
	created	7,800	7,800	0	7,800	7,800
19. Enhance and protect critical winter habitat for selected resident wildlife species.	Antelope (acres)	501,700	251,000	251,000	0	250,700
	Mule deer (acres)	510,000	255,000	255,000	0	255,000
	Elk (acres)	171,300	171,300	171,300	0	0
	Moose (acres)	73,500	73,500	73,500	0	0

1/ Year 2000 need includes 1980 time frame need.
2/ Needs satisfied by plan element for specific Study Objective 1.
3/ Need figure used here is for the year 2020.
4/ Needs satisfied by plan elements for specific Study Objectives 1, 3, and 6 exceed 100,000 AUMs.

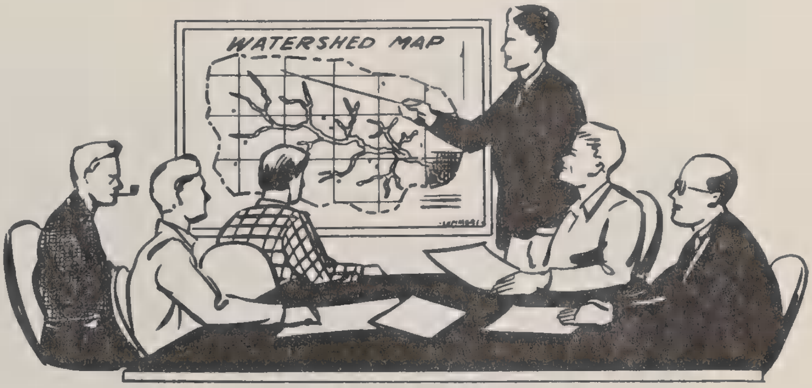
CHAPTER III

INTRODUCTION

CHAPTER II
INTRODUCTION

The Green River Basin is experiencing significant increases in the use of its natural resources. Efforts of mineral industries to supply local and national needs have caused a rapid increase in resource development and population levels. These developments and associated population growth, plus the intensified outdoor recreation demand from both within and outside the basin, are exerting strong pressure on the natural resources of the area and the existing socioeconomic institutions. Along with mineral development, agriculture, forestry and wildlife, summer home developments are competing for the same resource base. Thus, there is a need for improved coordination among resource users and managers to find solutions to natural resource and socioeconomic problems and needs. Improved coordination and cooperation should lead to: (1) more efficient use of water and land; (2) the orderly and coordinated development of resource potentials; (3) preservation and enhancement of fish and wildlife habitat; and (4) protection of cultural and historical resources.

The demands on resource use as well as the desires of the Wyoming Legislature "to undertake feasibility and financing studies to make maximum beneficial and multiple use of Wyoming's water in the Green River and Great Divide Basins" were the main reasons for the implementation of this study.



Authority for the Study

In July 1967, the Wyoming State Engineer's Office, acting for state agencies with an interest in water and related land resources, requested the U. S. Department of Agriculture to undertake a Cooperative River Basin Study of the Green River and Great Divide Basins. The U. S. Department of Agriculture agreed to participate under the authority and provisions of Section 6 of Public Law 82-566, the Watershed Protection and Flood Prevention Act, as amended. Authorization for this study was given in August 1968; however, staffing shortages delayed the start of the study until late 1973.

Study Participants

This was a cooperative federal, state and local study. Citizen groups were involved in all phases of the study. Study participants

consisted of: USDA agencies--Soil Conservation Service (SCS), Economics, Statistics and Cooperatives Service (ESCS) and Forest Service (FS)--and the State of Wyoming. Participation by the U.S. Department of Agriculture was in accordance with a Memorandum of Understanding among the ERS (now ESCS), FS, and SCS dated February 2, 1956 and revised April 15, 1968.

The study was carried out under the general guidance of the U.S. Department of Agriculture Field Advisory Committee, composed of a representative from the SCS, ESCS and FS. The SCS provided leadership in carrying out the U.S. Department of Agriculture's responsibilities in the study. Personnel assigned to the study by the three agencies functioned as a study team under the guidance of the Field Advisory Committee. Each agency had responsibility for certain aspects of the study as outlined in a plan of work approved by the Committee.

Description of the Study Area

The Green River Basin is that portion of the Upper Colorado River Subregion located in the State of Wyoming. It includes the Great Divide

Forest land and rangeland - Wyoming Range

Soil Conservation Service

Basin, all of Wyoming drained by the Green River and its tributaries, and the Little Snake River drainage and its tributaries located in Wyoming. The Green River Basin extends north from the Wyoming-Colorado-Utah stateline about 168 miles. Roughly triangular in shape, it is about 213 miles wide at the baseline and contains about 21,049 square miles or 13,471,500 acres. An estimated 3,916 square miles are in the Great Divide Basin, a closed topographical area, east of and adjacent to the Green River Drainage. The Green River Basin includes virtually all of Sweetwater County and parts of Uinta, Teton, Lincoln, Sublette, Fremont and Carbon Counties.

Elevations within the basin range from 6,040 feet near the Wyoming-Utah state line to 13,785 feet above sea level at Gannett Peak, northeast of Pinedale. The northern rim of the basin is largely above timberline and topography is rough and broken. The midslopes are wooded uplands dissected by streams and flanked with mountain meadows. The floor of the basin is a high, arid plain with midgrasses and sagebrush vegetation. The topography of the Great Divide Basin includes badlands, mesas, bluffs and dry gulches.

High, arid plains, Great Divide Basin

Soil Conservation Service

Average precipitation varies from seven inches in the Great Divide Basin to 60 inches at the higher elevations. Glaciers and heavy snowpack in the mountainous areas provides abundant water to the Green River and its tributaries. In contrast, the basin floor contributes very little water to the river system. The Great Divide Basin contributes no surface water to the Green River nor any other river system.

Temperature extremes range from just over 100^{0}F to minus 55^{0}F. Winters are long and severely cold. Due to the basin's high elevation, nearly any location can experience a freezing temperature any day of the year. The growing season for agricultural crops is less than 80 days in the northern portion of the basin and increases to 130 days in the southern portion. Because of the short growing season and arid conditions, cropland is limited to areas adjacent to the permanent streams.

The agricultural economy consists almost entirely of cattle and sheep. Livestock and livestock products account for over 95 percent of the value of all farm products sold. Although farm earnings have increased, they accounted for only seven percent of the basin's total earnings in 1970 compared to 13 percent in 1950. There are about 1,000 farm-ranch units in the basin producing about $22 million worth of agricultural products and transacting $6 million worth of business with local merchants.

Multiple use of rangeland - cattle, wildlife and energy
Soil Conservation Service

The basin contains 1,739,890 acres of forested lands. Only 542,390 acres (40 percent), however, are classified as commercial forest. During the period 1969-73, total yearly roundwood harvest averaged 7.4 million cubic feet with sawtimber accounting for 95 percent of the total.1/ Although this rate of harvest is less than the estimated annual net growth, it is doubtful that this level of harvest can be maintained. Additionally, esthetic, environmental and wildlife uses are competing with the increasing demand of energy development, mining and recreation for forestland resources.

The major mineral resources of the basin consist of natural gas, crude oil, trona, coal, oil shale and uranium. The oil and gas industry produced a gross value of $122 million in 1974. This represents the most significant activity in the basin's economy. However, other mineral development activity is rapidly increasing. The largest known deposits of commercially minable trona (soda ash) in the world are in the Green River formation. About 67 billion tons of trona of known reserves are in and adjacent to the Green River Basin. Trona mining and processing is developing rapidly and is becoming a major activity in the basin's economy.

Massive strippable coal reserves provide the base resource for a growing thermal power industry, for coal exports and for potential

Harvesting commercial forest land
Forest Service

1/ Roundwood - logs, bolts, or other round sections cut from trees for industrial or consumer use. Sawtimber - trees large enough to contain one log suitable for manufacture of lumber.

synthetic fuel plants. Coal production declined from four million tons in 1950 to one-half million tons in 1960. However, production has increased rapidly since 1970. The Jim Bridger power plant alone is expected to consume over 6.0 million tons of coal annually by 1979. Oil shale underlies about 4.2 million acres of the Green River Basin and holds potential for a substantial syncrude industry. However, given the current state of processing technology, economics and environmental consideration, it would appear that any development of this resource is not likely in the near future. The northeastern quarter of the basin holds good potential for commercial uranium development. The exact amount and quality of the reserves is not known. In recent years, intense exploration has been carried on, and some announcements of mine development have been made.

Outdoor recreation in the Green River Basin is important to the basin's economy and in terms of land and water resource requirements. The Green River and its tributaries, the many mountain lakes and the large impoundments afford an excellent base for fishing, scenic values and other water-based recreation activities. The upper reaches of the basin contain a large designated wilderness area that presents pleasant scenic and outdoor recreational opportunities, as well as supplying a base for many types of hunting activity.

Jim Bridger power plant near Rock Springs
Pacific Power and Light Company

The basin has had a relatively small population--28,000 in 1970. However, since 1970, the population has grown rapidly to around 45,000 in 1975. In 1970 only the city of Rock Springs, with 11,657 residents, had a population larger than 10,000. The 1975 Rock Springs population was estimated to be 20,000. In 1970, 64 percent of the population resided in the communities of Rock Springs, Green River and Kemmerer. Given the nature and location of recent energy related developments, these three communities currently contain an even larger share of the basin's population.

CHAPTER III

PROBLEMS AND OBJECTIVES

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PROBLEMS AND OBJECTIVES

A variety of concerns were identified by the county public involvement groups and local and state agencies. These concerns are related principally to the use of land and water resources and the deterioration of environmental quality. The expressed concerns, hereafter referred to as problems, led to a request for this study from the State of Wyoming and were used to establish the study objectives given at the end of this chapter.

The problems evaluated in this study are listed below:

1. Shortage of late season irrigation water.
2. Salt loading in the Green River.
3. Inefficient use of irrigation water.
4. Low production and harvest and underutilization of wood fiber.
5. Degradation of rangeland and streambank quality from erosion.
6. Substandard condition and insufficient supply of recreation facilities.
7. Unused Colorado River Compact water.
8. Shortage of winter livestock forage.
9. Flooding of agricultural lands.
10. Deterioration of scenic stream corridors and other landscapes.
11. Insufficient management of archeologic, fossil and historic resources.
12. Loss or deterioration of fish habitat.
13. Loss or deterioration of wildlife habitat.

Shortage of Late Season Irrigation Water

A full season supply of irrigation water is not available in some of the irrigated areas of the basin. Residents of the basin and the Wyoming Water Planning Program staff indicated where major water shortages occur. Given current acreage and management practices, investigations of 23 watersheds in the basin indicates that the basin could utilize a total of 27,400 acre-feet of supplemental irrigation water at point of diversion on 60,700 acres of hayland (9).1/

1/ Numbers in parentheses throughout this report refer to sources listed in the bibliography.

Hayland near Big Piney illustrating late season water shortage Soil Conservation Service

Salt Loading in the Green River

The quality of intrastate waters in the basin is generally good and within the limits of regulations established by the Wyoming Environmental Quality Act of 1973. The most notable water quality problem on the Colorado River system is salinity. Salinity progressively increases downstream, and it particularly becomes a problem in the lower Colorado River Basin. Salinity standards have not been established for the upper Colorado River or tributaries in the upper basin at this time, primarily because the proportional contributions to salinity from man-made and natural sources are not known. The Federal Government is seeking ways to stabilize salinity in the Colorado River system through implementation of Public Law 93-320 (the Colorado River Basin Salinity Control Act).

The Big Sandy River, Blacks Fork River and Henrys Fork have been identified as three streams that are heavy contributors of salt to the Green River. Salinity analyses on the Big Sandy River by various agencies have shown differing results. The discharge of total dissolved solids (TDS) from the Big Sandy River to the Green River

ranges from approximately 510 tons per day (36) to 830 tons per day (20). TDS expressed in milligrams per liter (mg/l) for the Big Sandy River range from 388 to 4,240 with a mean of approximately 2,700 mg/l for the time period of 1968 to 1975. Hams Fork joins Blacks Fork several miles above the point where their combined flow enters Flaming Gorge Reservoir. The TDS in Blacks Fork River above the confluence with Hams Fork is estimated at 618 tons per day (20). U.S. Geological Survey water quality records (1964-1976) show TDS as expressed in mg/l to range from 277 as a low to 3,710 as a high for the period of record. Henrys Fork empties into Flaming Gorge Reservoir near Manila, Utah. The salt loading from Henrys Fork is estimated to be 359 tons per day (20). Water quality records as published by the U.S. Geological Survey, show TDS to range from 247 mg/l to 1,940 mg/l for the time period of 1969 to 1976.

In September 1977, the Southwestern Wyoming Water Quality Planning Association prepared a report on water quality that included most of the Green River Basin (14). From their study, nitrogen levels were not considered to be a problem or data were too incomplete for a definite conclusion. Phosphate levels were listed as unacceptable for most reservoirs in the basin in terms of esthetic and eutrophic criteria. However, because of insufficient data, these conclusions are tentative.

Inefficient Use of Irrigation Water

Overall irrigation water use efficiency is estimated to be 30 percent.2/ Efficiency probably varies from a low of 10 percent to a high of 60 percent. The level of irrigation efficiency also changes as the irrigation season progresses. In the spring and early summer when stream flows are high, efficiency is low. Later in the season when water becomes less abundant, efficiency increases. There are 205,200 acres of irrigated land with suitable soils that will respond to the land treatment measures necessary to improve irrigation efficiency. About 40,500 acres of this total have already been treated.

In most areas of the basin, irrigation efficiency is difficult to measure because diversion flows, deep percolation and return flows are not well documented. A major drawback of current efficiency estimates is that return flows or tailwater runoff onto other fields is not taken into account.

There are six major reasons for the relatively low irrigation efficiency levels: (1) flood irrigation technique used throughout the basin; (2) poorly designed and maintained diversion structures, canals and ditches; (3) unlined canals and ditches in highly permeable soils; (4) uneven topography; (5) high cost of operating labor and (6) the relatively low cost of water. Inefficient irrigation systems and practices can lead to other problems. One problem is the possibility of reducing the amount of water available for increasing irrigated acres or for other uses. This is important where water supplies relative to

2/ A discussion of water use efficiency is given in Chapter V.

Typical inefficient irrigation delivery system, Big Piney area
Soil Conservation System

demand are tight or shortages exist. The second problem is salt loading in the Big Sandy and Blacks Fork Rivers and Henrys Fork. It is known that an improvement in irrigation efficiency will reduce salt loading in these three tributaries to the Green River.

Low Production and Harvest and Underutilization of Wood Fiber

Sawtimber demand is increasing locally and nationally. Sawmill capacity adjoining and near the Bridger-Teton National Forest is upwards of 75 million board feet per year. On the other hand, sawtimber sale offerings in 1975 totaled only 35 million board feet. In the Green River Basin, sawtimber harvested from the Bridger-Teton National Forest in 1975 was 14.9 million board feet. An estimated 2.6 million board feet of sawtimber was harvested from state, private, National Resource lands,

and other national forest lands. The average annual production (net growth) of sawtimber in the basin is approximately 45 million board feet or 11.0 million cubic feet 3/ (5). It is estimated that under improved management practices and forest conditions, annual net growth could be increased to 21.7 million cubic feet.

There are several factors involved in making increased quantities of sawtimber available for harvest. First, there is a need for more complete inventories of the more accessible and potentially productive forest land, particularly those lands capable of producing 50 cubic feet per acre or more per year. This type of identification is especially

Typical small diameter timber stand with dead and dying trees   Soil Conservation Service

3/ Conversion from bd. ft. to cu. ft. is 4.358 bd. ft. equals 1 cu.ft.

needed on an estimated 83,500 acres of private and state forest lands. Second, there are fewer old growth sawtimber harvest areas where access and harvest will not create land and other environmental disturbances. Third, there is a strong demand to maintain more of the forested area for other values such as wildlife habitat, recreation and scenery.

Utilization and marketing of dead, diseased and small size timber is a continuing problem although some progress is being made. The large volume of present salvable dead wood and the large annual tree mortality invite pressure to increase harvest. However, the volume per acre is often so low that a commercial operation is impractical.

The presence of dead and dying timber and dense, stagnated sapling stands creates conditions for fire, disease and reduced growth. In some overmature lodgepole pine stands, the annual net growth rate ranges from a negative seven to a negative 15 cubic feet per acre per year. As overmature and overstocked areas are harvested and replaced by healthier and younger trees, the rate of growth should increase significantly.

Degradation of Rangeland and Streambank Quality by Erosion

Significant erosion problems are not extensive on hay, crop and pasture lands. On rangeland, sheet, gully, rill and streambank erosion occur in varying degrees of severity. Some 3,124,000 acres of rangeland have an annual erosion rate in excess of one-half ton per acre. No effort was made to separate the amount of erosion caused by geologic erosion versus accelerated erosion. The higher erosion rates, particularly for Red Creek, Adobe Town and other badland areas, are mostly geologic. Some of the higher erosion rates are in areas where rangeland vegetation cover is fair to poor. About one-half of the rangeland area is in fair and poor range condition.

Serious streambank and gully erosion problems in the basin are not widespread. Only 200 miles of gully and streambank erosion are considered serious enough to warrant treatment. Those areas needing treatment are: (1) Bitter Creek - 40 miles; (2) Salt Wells Creek - 30 miles; (3) Muddy Creek - southeast - 40 miles; (4) Little Muddy Creek - southwest - 80 miles; and (5) Little Snake River - 10 miles. Eroding streambanks also destroy riparian vegetation and yield sediment for downstream delivery. Bitter Creek drainage, for example, is estimated to contribute 77,000 tons of sediment to the Green River annually.

Sediment laden water can transport nutrients to streams and reservoirs. Sediment also reduces channel and reservoir capacities and degrades the aquatic ecosystem.

Wind erosion as it effects soil productivity was not considered a significant problem and; therefore, an analysis is not included in this report. Air quality problems from wind erosion could occur in the basin, but no investigations were initiated for this study.

Streambank erosion on Salt Wells Creek in the Bitter Creek drainage

Substandard Condition and Insufficient Supply of Recreation Facilities

The natural environment, as well as the presence of some man-made structures, makes the Green River Basin a desirable location for many types of outdoor recreational activities. In this report, only three major activities are evaluated--boating, camping-hiking and fishing. It is these three activities which have and will continue to have the greatest impact on the land and water resources and environment of the basin (7).

Boating

Boating in the basin drew an estimated 172,600 participations in 1970.4/ Participations are projected to increase to 271,000-308,000 by 1985. There is sufficient flat water in the major lakes and reservoirs at lower elevations to supply boating demands to the year 2020. However, there is a current shortage of adequate launching, docking, parking, and sanitation facilities at New Fork, Willow, Fremont, Half-Moon, Burnt and Boulder Lakes and at Big Sandy and Fontenelle Reservoirs. Additionally, access as well as facilities for boaters desiring to float the Green and New Fork Rivers are entirely lacking or insufficient. Easements across private land are practically non-existent. River floating is a growing sport in the basin but lacks adequate management.

Boating and fishing on Fremont Lake
Soil Conservation Service

4/ Participation - a recreation activity taking place during part of a 24-hour period.

Camping-Hiking

Basin-wide camping facility capacity is estimated to be adequate for 393,000 participants, and within the accuracy of the data, demand and supply in 1970 were about equal. However, this conclusion is valid only on a basin-wide basis. In specific areas of the basin, demand exceeds supply. Most camping facilities located on lakes and in National Forests are currently inadequate to handle peak demands. Expansion of existing campgrounds at Fontenelle Reservoir, Fremont Lake, and Big Sandy Reservoir are priority needs. Many commercial campgrounds are also overcrowded, not only with recreation campers, but also with semi-permanent campers employed in mining and energy development programs.

Problems associated with camping and hiking are many and result in major impacts on the wilderness environment. Many campsites are overused as evidenced by the numerous and increasing numbers of fire circles filled with ashes, charred wood and fire-blackened rocks. Instead of carrying their garbage out, many campers attempt to bury it or leave it lying on the surface. Pits dug for garbage are often only partially covered and house colonies of rodents among the discarded aluminum foil, plastic and styrene containers. The use of riding horses and pack horses is also causing some problems. In areas where horses have continually been tied to trees, trampling and erosion have exposed the tree roots and some trees are dying. Trailhead facilities for horses are inadequate.

Primitive campsites throughout the basin have a similar set of problems. Their dispersion prohibits frequent administration and cleanup. Many irresponsible people camping at unsupervised locations seem especially careless of fire, litter and use of firearms and off-road vehicles. Such carelessness adversely affects the quality of the recreation experience for other people as well as damaging and degrading site locations. Manpower is badly needed for more frequent patrol and to work with the public to achieve greater awareness of individual responsibilites.

Most public campgrounds need improved sanitation facilities, water systems, road and trail surfaces, traffic control and maintenance. Because of increased use and changes in outdoor recreation use patterns, maintenance and reconstruction of existing facilities have become a major problem. The most notable change in facility use has been the shift from tents and campers to self-contained trailers and motor homes. Most older facilities were not designed to accommodate the latest camping equipment. Maintenance and reconstruction for these recreation activities becomes a problem of redesign and new construction.

Other factors which have increased maintenance problems and administrative costs are vandalism and littering, plus on-site administrative costs to collect campground fees and reservations. All of these problems are recognized by the various administrative and enforcement agencies. But, without increased funds and manpower, only limited improvements can occur. In 1976, on National Forest lands, only 50 percent of the funds needed for maintenance and reconstruction were available.

Picnic Grounds

The basin contained 26 improved picnic areas in 1975 with an estimated capacity of 1,087 persons at one time. The majority of the picnic grounds are associated with municipal and county park and recreation areas. If the projected population levels materialize (3), an estimated 88 additional picnic areas will be required by 2000.

Fishing

Based on a high level population projection, continued increases in nonresident fishermen, fishing demand on the basin's streams will equal capacity by 1979-1980 (7). Using a lower level population projection, demand will equal capacity in 1985. Capacity is based on miles of classified fishery which includes both accessible and inaccessible streams.

Access to many reaches of the Green River and its tributaries is a major problem. Access to lakes and reservoirs is a lesser problem.

Stream fishing for trout

Forest Service

An estimated 1,059 miles of rivers and streams, or 35 percent of the minimum fishery miles, need additional access 5/ (4). An estimated two percent of the total lake and reservoir area needs more access. Public access to streams and rivers can also cause problems. Vehicle movement is not restricted at many of the access points. Thus, vehicles are often driven to and along the streambanks and in the streams creating erosion and deterioration of streambank vegetation and fish habitat. In some places litter abounds. An estimated 1,040 miles of fish habitat in the basin is declining in quality from various man-made and natural causes.

Unused Colorado River Compact Water Allocated to Wyoming

The outflow of water from Wyoming into the Colorado River system averaged 1,841,000 acre-feet annually for the years 1930-1973. Of the total average discharge, 371,800 acre-feet came from the Little Snake River drainage.

The Colorado River Compact of 1922 divided the water of the Colorado River system between the upper and lower basins, with Lee Ferry, Arizona being the dividing point. The Upper Colorado River Basin Compact of 1948 divided the upper basin's share, defined in the 1922 Compact, among the upper basin states. Wyoming's share of water originating in the Green River and Little Snake River drainages, based on the 1948 Compact, varies from an estimated 805,000 to 1,043,000 acre-feet. The principal reason for the variance is that there has not been agreement on the level of deliveries the upper basin (part of Colorado, Arizona, New Mexico, Utah and Wyoming) must deliver under the Compact to the lower basin (Arizona, California, Nevada, parts of New Mexico and Utah). After current depletions of 332,200 acre-feet plus Wyoming's share (73,000 acre-feet) of Colorado River Storage Project Evaporation (CRSP), an estimated 399,800 to 637,800 remain available for use in Wyoming. Citizens and the legislature in Wyoming believe it is important to plan for the beneficial development and practical uses for this water (8,27).

For this study, the most conservative estimate of 805,000 acre-feet was used. Present depletions (1975) were estimated by the state to be 405,200 acre-feet. This leaves 399,800 acre-feet available for use. Projected and committed future depletions will reduce the amount available to an estimated 188,200 acre-feet by the year 2020.

Livestock Winter Forage Production

Total livestock forage production in the Green River and Great Divide Basins is adequate for current livestock and wildlife numbers (2). Total animal unit equivalents, except for year to year variations, have remained relatively constant at about 232,000. In recent years there has been a substantial shift from sheep production to cattle production. Although total forage production is still adequate, this shift has created two problems for ranchers in the basin. The main

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5/ Minimum fishery miles - stream miles that produce fishery resources as classified by the Wyoming Game and Fish Commission Stream, River and Lake Inventory.

problem has been a tightening of winter feed supplies (hay and aftermath grazing) for cattle in some areas of the basin. Based on projections of livestock numbers and projected winter feed supplies, there could be a shortage of winter feed in the amount of 100,000 AUMs by the year 2000.

Stacking hay for winter livestock feed, Pinedale area
Soil Conservation Service

Another problem is one of not being able to convert sheep grazing permits on public lands to cattle permits as rapidly as ranchers would prefer. Part of this problem stems from the fact that much of the range in mountainous terrain is more suitable for sheep than for cattle. Also, certain non-mountainous areas may be more suitable for sheep due to the mix of vegetation present and availability of water. This study only evaluates the need for increased winter feed supplies.

Flooding

Watershed investigations conducted throughout the basin indicate that flood damage to agricultural lands in the basin has been minimal. Through the years there have been flood events which have caused overland flows on much of the pasture and hayland. While historical records show little evidence of significant flood damage to agricultural land or crops, further investigation will be needed to determine preventable flood damages (6,34).

Bitter Creek and the Little Snake River are the only two watersheds where significant flood damage has occurred and where potential for damage still exists (Table III-1). Bitter Creek is particularly a threat to the urban area of Rock Springs. This watershed consists of about 2,207 square miles and has a long history of flooding the town of Rock Springs. Considerable property damage has occurred on numerous occasions in the past and several lives have been lost as a result of floods. The Army Corps of Engineers has periodically examined flood problems on Bitter Creek and other tributaries near Rock Springs since 1938. The Corps has found improvements not economically feasible. However, the city has completed some recent improvements which consist of channel realignment, deepening and widening. The City Engineer presently estimates the capacity of the channel, now partially filled with silt, from 5,000 to 9,000 cfs. A Flood Insurance Study completed by the Corps of Engineers in 1974 estimated the peak discharge of the one percent chance flood event in Rock Springs is nearly 15,000 cfs. Thus, past efforts have not totally alleviated the potential for flood damage to Rock Springs. Besides damage to the city, damage can also occur to segments of state and federal highways and the Union Pacific Railroad.

Bitter Creek channel through Rock Springs
Soil Conservation Service

Table III-1. Average Annual Flood Damages, Green River Basin, Wyoming

Stream	Average Annual Flood Damage
	Dollars
Upper Green River (above Fontenelle Dam)	N.A. 1/
Lower Green River (Fontenelle Dam to Flaming Gorge Reservoir)	Minimal
Hams Fork	1,000 2/
Blacks and Smiths Fork	8,000 3/
Big Sandy River	Minimal
Little Snake River	89,000 4/
Henrys Fork	N.A. 1/
Bitter Creek	47,000 5/

1/ Not available for long-term period.
2/ Soil Conservation Service, Preliminary Investigation Report
3/ Bureau of Reclamation, Definite Plan Report Supplement, April 1976, Report for the Construction of Stateline Dam.
4/ Bureau of Reclamation, Preliminary Draft Final Plan Report, Savery-Pothook Project.
5/ Upper Colorado Region, Comprehensive Framework Study, Appendix IX, Flood Control.

High stream flows in the Little Snake River have flowed overland many times, flooding agricultural lands, but damage has been minimal. Flood damage in the Little Snake River Basin consists chiefly of erosion damage to river banks and irrigation diversion structures (23). Damage to urban settlements and residental or commercial property has been small.

Although this study recognizes that the potential for flooding on Bitter Creek and the Little Snake River still exists, further detailed evaluation was not conducted. Periodic flooding of wetlands and flood plains does occur during unusually heavy snowmelt but damage losses are not sufficient to justify Corps of Engineers expenditures for flood control improvement unless it is incorporated in multi-purpose projects. Flood control by USDA programs does not appear to be feasible at this time. Thus, no study objective was developed for this concern. In both cases, any upstream projects implemented to control potential

flooding will involve coordination and cooperation between private, state and federal lands as well as the urban areas involved.

Deterioration of Scenic Stream Corridors And Other Landscapes

The Wyoming Game and Fish Commission has classified esthetics on 3,568 miles of stream corridors (4). The visual quality of 780 miles of these streams has deteriorated because of various kinds of human activity, livestock use and natural occurrences. On some stream channels, natural erosion and overland flooding has downgraded scenic values. Stream channels have been altered with car body and tree and brush revetments, rock riprap, oxbow cuts, jetties and channel straightening. Livestock concentrations are quite heavy along some streams particularly in the winter and have led to streambank deterioration. Use of vehicles in and along streams has created bank erosion and deterioration of streambank vegetation.

Natural stream setting, South Piney Creek
Soil Conservation Service

Stream dominated by man's activities - heavy livestock use

Major landscape disturbances throughout the basin are caused by mining, oil and gas drilling and exploration, urban sprawl, livestock overgrazing, highway construction, fencing and cross-country recreational vehicle use.

Concentrated Use in Local Areas Within Wilderness Management Units

Excessive and concentrated use in Jim Bridger Forest Wilderness Area by man and livestock is lowering the visual quality, the wilderness experience and the fish and wildlife values. Concentrated use of certain trails and campsites is the main problem. With the present level of use, satisfactory dispersal of all forms of recreational use has not been accomplished on the 576 miles of trails. A few trails are improperly located and constructed, and are causing erosion. Other trails are unsafe because of poorly maintained or inadequate bridges. Overuse of campsites results in vegetative deterioration and excessive littering.

Insufficient Management of Archeologic, Fossil and Historic Resources

Archeological Resources

The Green River Basin contains a wealth of archeological sites. Thus far, 800 sites on 80,000 acres of an estimated 424,000 acres of artifact-rich areas have been recorded. Numerous additional sites remain to be discovered and classified. Many of the known sites have not been extensively investigated. There is little organized effort being made to protect known sites. Amateur collection and vandalism are widespread with valuable artifacts being removed or destroyed. Also, because of extensive exploration for minerals, numerous sites may be unintentionally and unknowingly damaged or ruined (4).

Fossil Resources

Significant fossil-rich sites in the basin have been known about for over 100 years. To date, only 2,009,000 acres of an estimated 9,430,000 acres containing fossils have been adequately investigated for the remains of prehistoric organisms. Organized and coordinated efforts to protect and preserve fossil-rich areas are incomplete. Consequently, because of vandalism and mineral exploration, valuable scientific knowledge may have been lost or destroyed (4).

Historical Resources

The Green River Basin, having been the crossroads for early trappers, fur traders and immigrants, contains numerous historical sites. There have been 127 significant historical sites identified; 14 have been placed on the national register. The location of many historical sites and trails and their significance has been marked with signs and monuments or other types of markers. However, the locations of some significant historical events are obscure, or have never been clearly marked (4).

Vandalism is a major problem with historical signs and markers. For example, many of the Oregon Trail medallions, set in concrete post markers, have been cut out with chisels. In other instances, signs and monuments have been defaced or completely removed from their mountings. Energy exploration and development also has had its impact on historic trails and sites. An example is the Fort Bridger Trail west from Green River where long stretches of this trail have been destroyed for a new road.

Loss or Deterioration of Fish Habitat

Generally, flat water fisheries in the basin are not declining in quantity or quality. However, river and stream fishery quality and quantity is suffering continued decline. Seasonal water flow shortages have been identified on 188 miles of fishery streams. These low flows decrease the potential of a stream to produce the number and size of preferred fish species.

The Wyoming Game and Fish Commission has designated 2,953 miles of streams and rivers in the basin as minimum fisheries. These miles contain minimum operating habitat for maintaining the present quantity and quality of fishing within the 3,958 miles of stream classified as perennial streams 6/ (4).

Of the 2,953 miles, 1,492 miles, or 50.5 percent, are classified as low to very low productive trout waters. The majority of these streams are so classified because of deterioration caused by human activity. These activities include stream channel alteration, stream dewatering and streambank deterioration from vehicles and livestock.

One thousand four hundred and sixty miles or 49.5 percent of minimum fishery miles are classified as premium, very important and important trout water.7/ The basic problem on these stream miles is maintaining this classification in the face of increased human activity in the vicinity of these streams and rivers. Another basic factor associated with the decline of river and stream fisheries is the lack of protective stream legislation.

There is concern that streamflows on the Green River below Fontenelle Reservoir may be reduced below fishery needs if current storage in the reservoir is used for other purposes. Those sharing this concern feel that instream flow to maintain fishery requirements should be considered a beneficial use of water and that the necessary water be protected from appropriation. However, it should be noted that Fontenelle Reservoir storage would be expected to be used for the purposes specified in the reservoir permit (No. 6629R), and in accord with the 1962 and 1974 contracts between the United States and the State of Wyoming. The 1974 contract required that water be held in storage for release in the amounts required to provide a minimum flow of 50 cfs at the USGS gage 09217000 below Green River, Wyoming. There are also diversion restrictions in the 1974 contract designed to provide a flow of at least 300 cfs at the I-80 crossing of the Green River.

Loss or Deterioration of Wildlife Habitat

Encroachment on wildlife habitat in the Green River Basin is increasing rapidly. In the past, man's occupancy of range and forest wildlife habitat has been seasonal and short term. This has changed recently with the development of the basin's minerals, the movement of populations to outlying areas and the clamor for outdoor recreation. New roads, drill rigs, off-road vehicle use, desert and forest residences and other forms of temporary and long-term encroachment affect wildlife habitat. Many types of wildlife habitat are affected. The most serious problem is where encroachment and overuse adversely affect critical winter habitat for mule deer, elk, antelope and moose.

6/ Minimum fishery miles - stream miles that produce fishery resources as classified by the Wyoming Game and Fish Commission Stream, River and Lake Inventory, March, 1977.

7/ See Appendix II for a complete description of these classifications.

For sage grouse and similar upland birds, encroachment on breeding grounds and other limiting habitat is the most serious problem (4).

Wetlands Habitat for Waterfowl

Shallow wetlands and adjacent land for waterfowl breeding are limited in supply. The potential exists to create an additional 10-15,000 acres of waterfowl breeding areas in Sublette Flat near Big Sandy Reservoir. There is a need to develop 7,800 acres of this area by 2000. Existing wetlands in the form of lakes, ponds, reservoirs, phreatophyte communities and seeps receive waterfowl use below their potential. It is desirable to improve habitat quality on 19,000 acres by 2000.

Critical Habitat for Selected Resident Wildlife Species

Critical winter range for mule deer, elk, antelope and moose are producing food and cover below their potential. In addition, most of these limiting habitats are on private land, a situation which does not allow for the direct protection and management of habitat by a public wildlife agency. Critical habitat enhancement and protection needs are given below for individual species. Many critical species habitat areas overlap making those acres even more valuable.

Mule deer - Enhance and protect 1,030,000 acres of critical winter habitat.

Elk - Enhance and protect 766,000 acres of critical winter habitat.

Antelope - Enhance and protect 1,762,000 acres of critical winter habitat.

Moose - Enhance and protect 328,000 acres of critical winter habitat.

Objectives

The U.S. Water Resources Council has established that the overall purpose of natural resource planning will be to improve the quality of life through contributions to the national objectives of national economic development (NED) and environmental quality (EQ). The NED objective is reflected by an increase in the value of the nation's output of goods and services and/or an improvement in the economic efficiency of production. The EQ objective involves the management, conservation, preservation, restoration or improvement of the quality of natural and cultural resources and ecological systems.

One or more specific study objectives were developed for each of the problems identified except flooding. A study objective for flooding was not developed because of minimal damage to agricultural land and small opportunity for USDA programs. Each of the problems, for which study objectives were developed, was analyzed under both of the national objectives. The problem of salt loading was included only under the national economic development objective. This inclusion differs from other

Colorado River salinity control studies which also recognize the problem under the environmental quality objective. An analysis of the problem indicated that corrective measures on irrigated lands to reduce salt loading would have net adverse environmental effect in the basin. Some significant adverse effects would be the losses of wetlands, open ditches, and ditch bank vegetation. Study objectives derived from the various problems are grouped by national objectives in Table III-2.

Table III-2. Problems and Objectives, Green River Basin, Wyoming

National Objectives	Problems or Public Concerns	Study Objectives
National Economic Development (NED)	Shortage of late season irrigation water.	1. Improve irrigation water supplies for late season use.
	Lowered usability of water to downstream users caused in part by salt loading in the Green River.	2. Reduce salt loading of the Green River from the Big Sandy and Blacks Fork Rivers and Henrys Fork.
	Inefficient use of irrigation water.	3. Improve irrigation water use efficiency.
	Low production and harvest and underutilization of wood fiber.	4. Increase the utilization of fuelwood and small wood products.
		5. Increase roundwood production and harvest.
	Degradation of rangeland and streambank quality from accelerated erosion.	6. Reduce erosion on rangeland.
	Substandard condition and insufficient supply of recreation facilities.	7. Improve management of the present recreation activity opportunities and recreation facility maintenance program.
		8. Increase the supply of recreation facilities.
	Unused Colorado River Compact water.	9. Utilize available Colorado River Compact water in basin.
	Shortage of winter livestock forage.	10. Increase production of winter livestock forage.
Environmental Quality (EQ)	Deterioration of scenic stream corridors and other landscapes.	1. Protect and enhance scenic stream corridors.
		2. Reduce concentrated use in local areas within wilderness management units.
	Insufficient management of archeologic, fossil and historic resources.	3. Identify and protect significant archeological and fossil areas.
		4. Preserve historic sites.
	Degradation of rangeland and streambank quality from accelerated erosion.	5. Reduce erosion on rangeland.
		6. Reduce streambank erosion.
	Loss or deterioration of fish habitat.	7. Provide minimum flows for a viable fishery on certain streams.
		8. Maintain fishing stream quality.
	Loss or deterioration of wildlife habitat.	9. Enhance and create waterfowl habitat.
		10. Enhance and protect critical winter habitat for four resident wildlife species.
	Unused Colorado River Compact water.	11. Utilize available Colorado River Compact water in basin.

Table III-2. Problems and Objectives, Green River Basin, Wyoming

National Objectives	Problems or Public Concerns	Study Objectives
National Economic Development (NED)	Shortage of late season irrigation water.	1. Improve irrigation water supplies for late season use.
	Lowered usability of water to downstream users caused in part by salt loading in the Green River.	2. Reduce salt loading of the Green River from the Big Sandy and Blacks Fork Rivers and Henrys Fork.
	Inefficient use of irrigation water.	3. Improve irrigation water use efficiency.
	Low production and harvest and underutilization of wood fiber.	4. Increase the utilization of fuelwood and small wood products.
		5. Increase roundwood production and harvest.
	Degradation of rangeland and streambank quality from erosion.	6. Reduce erosion on rangeland.
	Substandard condition and insufficient supply of recreation facilities.	7. Improve management of the present recreation activity opportunities and recreation facility maintenance program.
		8. Increase the supply of recreation facilities.
	Unused Colorado River Compact water.	9. Utilize available Colorado River Compact water in basin.
	Shortage of winter livestock forage.	10. Increase production of winter livestock forage.
Environmental Quality (EQ)	Deterioration of scenic stream corridors and other landscapes.	1. Protect and enhance scenic stream corridors.
		2. Reduce concentrated use in local areas within wilderness management units.
	Insufficient management of archeologic, fossil and historic resources.	3. Identify and protect significant archeological and fossil areas.
		4. Preserve historic sites.
	Degradation of rangeland and streambank quality from accelerated erosion.	5. Reduce erosion on rangeland.
		6. Reduce streambank erosion.
	Loss or deterioration of fish habitat.	7. Provide minimum flows for a viable fishery on certain streams.
		8. Maintain fishing stream quality.
	Loss or deterioration of wildlife habitat.	9. Enhance and create waterfowl habitat.
		10. Enhance and protect critical winter habitat for four resident wildlife species.
	Unused Colorado River Compact water.	11. Utilize available Colorado River Compact water in basin.

CHAPTER IV

RESOURCE USE AND MANAGEMENT GOALS

CHAPTER IV
RESOURCE USE AND MANAGEMENT GOALS

This chapter sets forth the quantity and quality of resource development needed to meet future goals or desires. Future goals were established by the Field Party through interaction with various government agencies and publics. The desired future conditions were quantified for each of the study objectives listed in Table III-2 at the end of Chapter III, and are based on desired future goals to be achieved, given the changes expected in economic and environmental conditions.

Economic and Environmental Goals

Agriculture

Residents of the basin and the State of Wyoming are interested in the continued development of agriculture and industry while also protecting the environment. The agricultural resources are uniquely suited for livestock production, particularly range cattle and sheep. Thus, the viability of the basin's agricultural economy depends on continued increases in efficient output of cattle and sheep.

The desired future for agriculture is for red meat production to increase. This increase provides for larger cattle and sheep numbers in 1980 and 2000 than would be required to meet national OBERS projections1/ (Table IV-1). This table also shows the desired numbers of wildlife and free-roaming horse numbers (Figure IV-1). The wildlife numbers are consistent with the State Game and Fish Department's management plan. Total or free roaming horses in the basin include the number of horses

Table IV-1 Desired livestock, horse and wildlife numbers, Green River Basin, Wyoming

Type	Year					
	1980		2000		2020	
	Desired	OBERS	Desired	OBERS	Desired	OBERS
Cattle 1/	192,235	177,580	244,620	235,240	280,680	293,750
Sheep 1/	201,275	137,285	194,235	106,135	189,950	137,075
Antelope	40,000	-	62,000	-	62,000	-
Deer	42,310	-	42,800	-	42,800	-
Elk	7,150	-	8,450	-	8,450	-
Moose	3,640	-	3,640	-	3,640	-
Horses:						
Wild	6,000	-	1,200	-	1,200	-
Domestic	8,170	-	8,170	-	8,170	-

1/ Cattle and sheep are the only items in this table for which OBERS projections were available.

1/ OBERS is an acronym for Office Business Economics, U. S. Department of Commerce and Economic Research Service, USDA. OBERS projections are traditionally used in river basin studies as a base of comparison for national economic needs and benefits.

listed in the Bureau of Land Management's draft wild horse management plan for the Big Sandy River Area.

These levels of animal numbers translate into feed requirements given in Table IV-2. Forage for wild and free roaming horses is included in the table.

Table IV-2--Feed production needed to meet desired livestock and wildlife numbers, Green River Basin, Wyoming

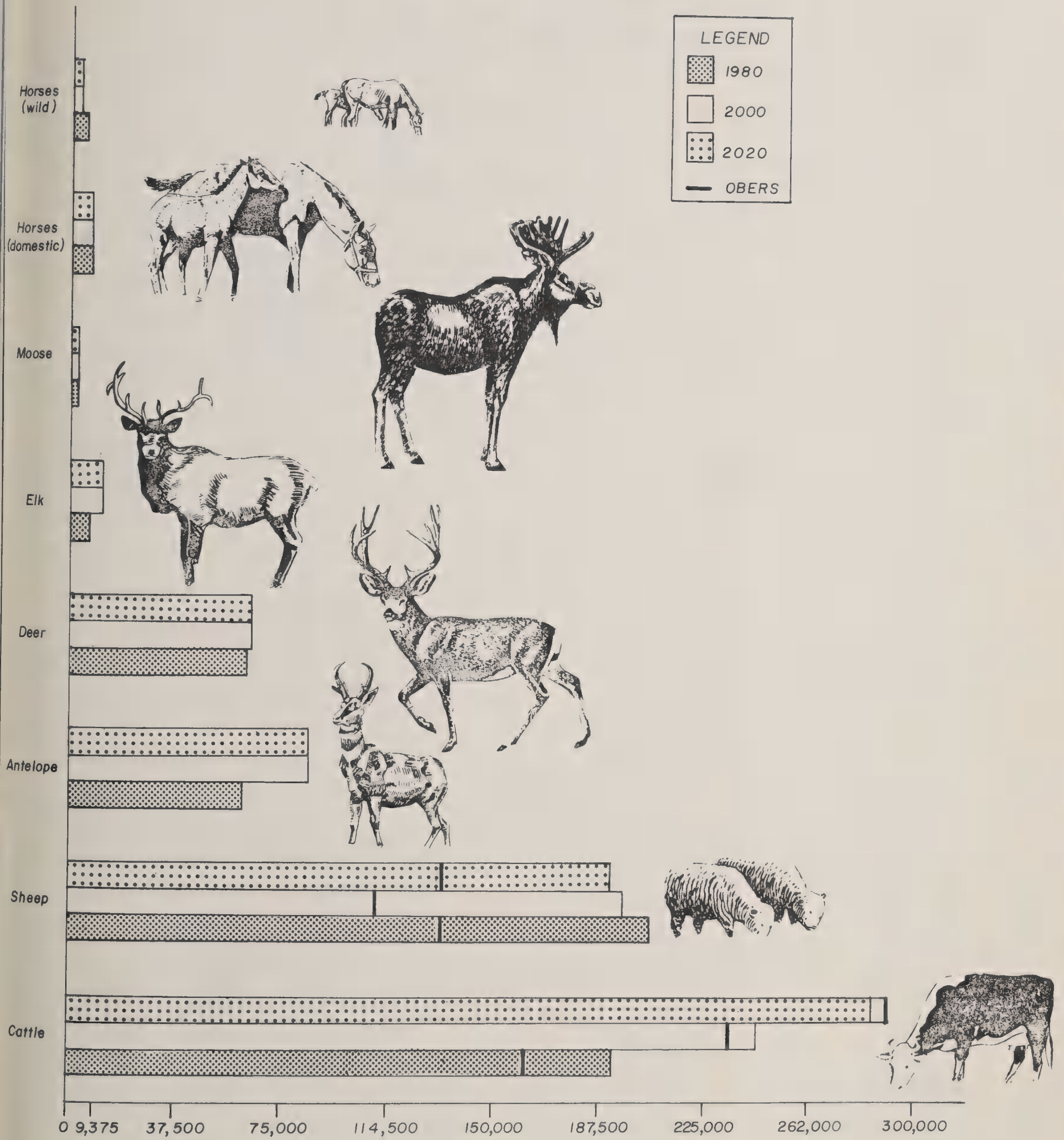
Type of Feed	Year		
	1980	2000	2020
	(AUM's)		
Hay and Aftermath	1,150,995	1,464,650	1,680,560
Pasture and Range	1,803,245	2,008,050	2,152,045
Total	2,954,240	3,472,700	3,832,605

Forest Lands

From 1969-73 the average annual harvest of roundwood in the basin was 7.4 million cubic feet. If the basin is to continue to provide its

Post and pole production in the Lyman area
Forest Service

Figure IV-1 Desired livestock, horse and wildlife numbers, Green River Basin, Wyoming



share of estimated national requirements, 84 million cubic feet of roundwood harvest would be required by 2000. This level of production is far greater than the productive capability of the commercial forest lands in the basin. Under improved management practices, harvest could be increased to at least 21.7 million cubic feet by 2000. This level of harvest would be equal to estimated annual net growth. However, even this level of harvest might not be realized because of other conflicting uses.

Specific Economic and Environmental Goals

Table IV-3 quantifies the goals by time frame for each of the specific study objectives listed under National Economic Development in Table III-2. Table IV-4 quantifies the goals by time frame for each of the specific study objectives listed under Environmental Quality in Table III-2. It should be noted that the specific goal levels assigned to each of the objectives were not given to the study team by any specific group or agency. The specific values were developed by the study team from comments and information obtained at public participation meetings and from local, state and federal agencies who are responsible for programs related to the problems and concerns discussed in Chapter III.

Table IV-3 Future goals for the national economic objective, 1980, 2000, 2020, Green River Basin, Wyoming

Specific study objective	Units	1980	2000 1/	2020 1/
		Goals		
1. Improve irrigation water supplies for late season use.	Acres annually supplied with late season water	60,700	60,700	60,700
2. Reduce salt loading of the Green River from the Big Sandy and Blacks Fork Rivers and Henrys Fork.	Watersheds studied and conservation measures initiated	0	3	3
3. Improve irrigation water use efficiency.	Acres (thousands)	60.5	140.5	205.2 2/
4. Increase annual utilization of fuelwood and small wood products.	Poles (each)	72,160	74,450	74,450
	Posts (each)	11,840	14,150	14,150
	Fuelwood (cords)	2,780	3,370	3,370
5. Increase annual roundwood production and harvest. 3/	MM cubic feet roundwood harvested	14.6	21.7	21.7
6. Reduce erosion on rangeland.	Acres with erosion rate below 0.5 tons/ac./yr. (thousands)	9,000.0	10,000.0	11,685.8
7. Improve management of the present recreation activity opportunities and recreation facility maintenance.	Dollars required annually (thousands)	820.0	2,200.7	2,982.4
8. Increase recreation facilities.	a. Boat launching sites (no.)	12	23	36
	b. Campgrounds (no.) (25 units each)	42	55	71
	c. Fishing-miles of stream with access	2,441	2,953 4/	2,953
	d. Picnic grounds (no.) (3 units each)	47	114	147
9. Utilize available Colorado River Compact Water.	Acre-feet utilized annually	805,000 5/	805,000	805,000
10. Increase production of winter livestock forage.	AUMs (annually)	20,000	100,000	100,000

1/ Goal quantities include previous time frame amounts.
2/ Represents total acres that are feasible to improve efficiency.
3/ Pole and fuelwood quantities are included.
4/ Represents total classified fishing streams in basin.
5/ Represents minimum water available to Wyoming under the Colorado River Compact, as estimated by the Department of Interior. Available for new uses 188,200 acre-feet, after accounting for projected commitments through 2020.

Table IV-4 Future goals for the environmental quality objective, 1980, 2000, 2020, Green River Basin, Wyoming

Specific study objective	Units	1980	2000 1/	2020 1/
		Goals		
1. Protect and enhance scenic stream corridors.	Protected miles of stream corridor	1,426	2,788	3,178
2. Reduce concentrated use in local areas within wilderness management units.	Number of properly managed wilderness management units	11	11	11
3. Identify and protect significant archeologic and fossil areas.	Acres reconned			
	Archeological	80,000	424,000	424,000
	Fossil	2,009,000	6,578,500	9,430,000
4. Preserve historical sites	Sites adequately protected	50	127	127
5. Reduce erosion on rangeland.	Acres with erosion rate below 0.5 ton/ac./yr. (thousands)	9,000.0	10,000.0	11,685.8
6. Reduce streambank erosion.	Miles of excessive eroding streambanks treated	20	200	200
7. Provide minimum flows for a viable fishery on certain streams.	Miles of fishery stream corrected for water flow problems	70	188	188
8. Maintain fishing stream quality.	Miles of stream maintained	584	1,460	1,460
9. Enhance existing waterfowl habitat.	Acres enhanced	19,000	19,000	19,000
10. Create new waterfowl habitat.	Acres created	7,800	7,800	7,800
11. Enhance and protect critical winter habitat for four resident wildlife species.	a. Antelope (acres)	1,762,000	1,762,000	1,762,000
	b. Mule deer (acres)	1,030,000	1,030,000	1,030,000
	c. Elk (acres)	766,000	766,000	766,000
	d. Moose (acres)	328,000	328,000	328,000
12. Utilize available Colorado River Compact Water.	Acre-feet utilized (annually)	805,000 2/	805,000	805,000

1/ Goal quantities include previous time frame amounts.
2/ Represents minimum water availiabe to Wyoming under the Colorado River Compact, as estimated by the Department of Interior. Available for new uses 188,200 acre-feet after accounting for projected commitments through 2020.

CHAPTER V

RESOURCE BASE AND USE

CHAPTER V
RESOURCE BASE AND USE

Resource Base

Location and Size

The Green River Basin is located in southwestern Wyoming. The study area consists of all the land and water area of the tributaries to the Green River in Wyoming, plus the Great Divide Basin. The Great Divide Basin is a topographical depression adjacent to and lying northeast of the Green River Basin. Total area in the study encompasses 13,471,500 acres (21,049 square miles). The Green River and its major tributaries--New Fork River, Big Sandy River, Hams Fork, Blacks Fork River, and portions of the Little Snake River constitute the headwaters of the Colorado River system in Wyoming.

Politically, the basin area includes most of Sweetwater and Sublette Counties, large portions of Lincoln and Uinta Counties, about one-fifth of Carbon County, and small areas of Teton and Fremont Counties. Rock Springs is the largest city in the watershed with a population of about 20,000.

The basin was divided into five planning areas to provide more detail in the collection, analysis, and display of information (Figure V-1). Planning Area I includes the upper Green River and all of its tributaries above Fontenelle Reservoir. Area II generally includes the area east of the Green River from the Wyoming-Utah-Colorado State lines to the headwaters of Big Sandy River. Area III consists of Blacks, Smiths, and Hams Forks drainages west of the Green River below Fontenelle Dam. Area IV is the Great Divide Basin and Area V encompasses the Little Snake River drainage in Wyoming.

Climate

Climatic conditions vary from high, semi-arid plains and valleys to alpine, subartic mountains. Summers are short and cool with the maximum temperature seldom exceeding 100^{o} F. Winters are long and severely cold, with the minimum temperature of -55^{o} F. recorded at Farson. Due to the basin's high elevation--lowest elevation is 6,040 feet--nearly any location can experience a freezing temperature any day of the year. Growing season for most of the hay and pasturelands, which are located in Planning Area I, is less than 80 days. Growing season in the Lyman-Mountain View area (Planning Area III) varies from 100-110 days. The Little Snake River drainage in Planning Area V also has a 100-110 day growing season (Figure V-2).

Precipitation varies from less than seven inches at Fontenelle and Wamsutter to more than 60 inches along the Wind River crest. From 47 to 62 percent of the precipitation that falls on the plains occurs between April and September. Precipitation occuring between October and March is usually snow. During the fall, winter, and spring months large

Meadow pastureland in upper Green River Basin
Soil Conservation Service

snowpacks accumulate in the mountains which provide the water necessary for irrigation during the summer season.

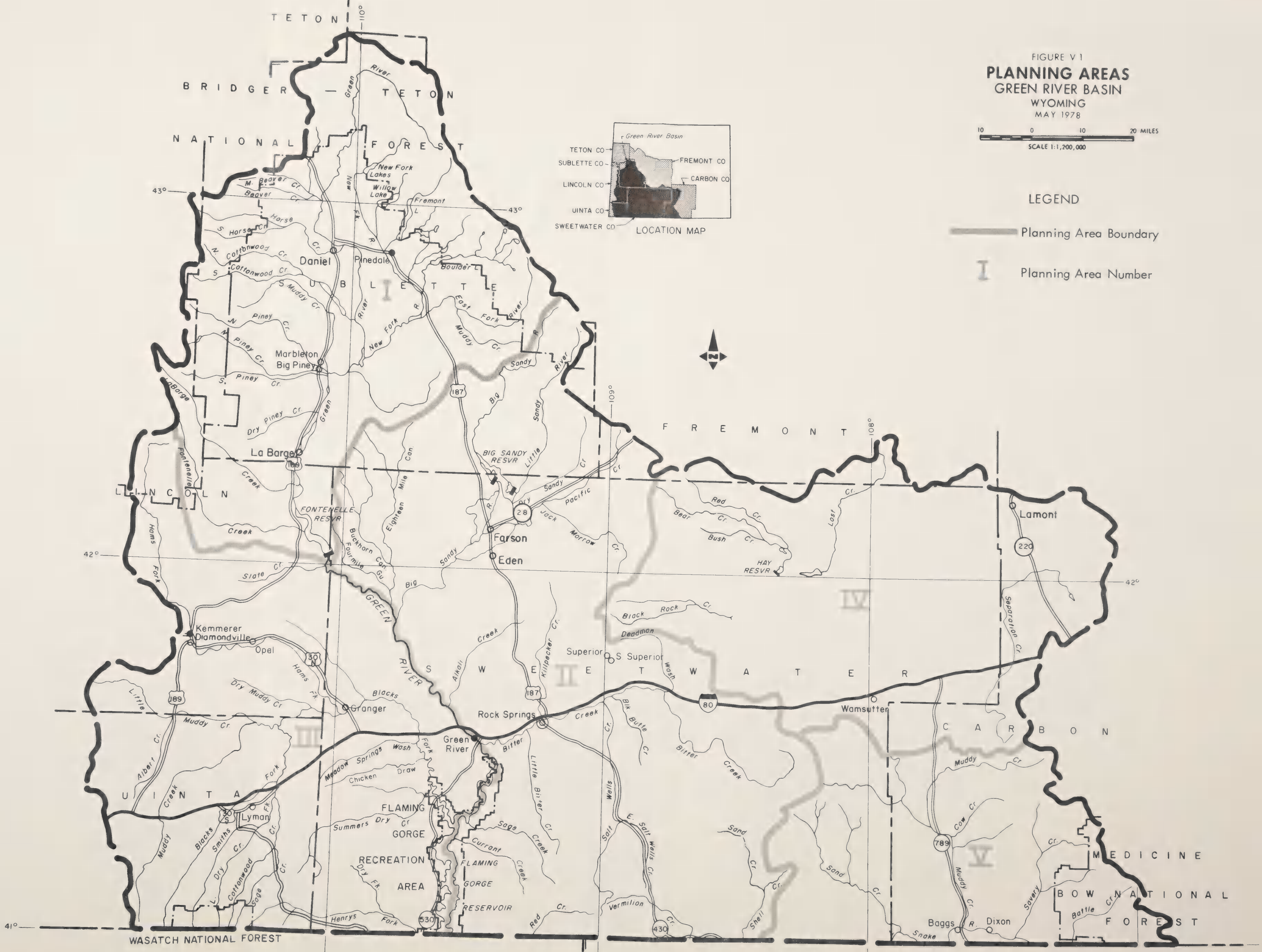
Sunshine is estimated to average about 70 percent of the possible daytime hours on an annual basis, ranging from about 55 to 60 percent during the winter and spring to about 75 to 80 percent during the summer and fall. Winds are relatively strong over the area, with the strongest winds during daylight hours. Winds average 12 mph daily with 15 mph winds in winter and spring and eight mph winds in summer and early fall. Strong winds of 30 to 40 mph occur infrequently.

Physiography

The Green River Basin is a high intermontane basin located in the southwest corner of Wyoming with elevations ranging from approximately 6,000 feet to over 13,000 feet. Historical South Pass on the Oregon Trail, which provided an easy crossing of the Continental Divide for thousands of travelers in the mid-1800's, is located in the central portion of the eastern boundary. The basin is bounded by the jagged, alpine peaks of the Wind River Range to the northeast, the Great Divide Basin to the east, the glaciated, east-west trending sedimentaries of the Uintas to the south, and the great faultblock mountains of the Wyoming Range to the west. To the northwest lies the Gros Ventre Range, a spur of the Wind River Range.

FIGURE V 1

PLANNING AREAS
GREEN RIVER BASIN
WYOMING
MAY 1978



Source:
Base map prepared by SCS, Portland Carto Unit from USGS 1:1,000,000 National Atlas.
Thematic detail compiled by Wyoming State Staff.

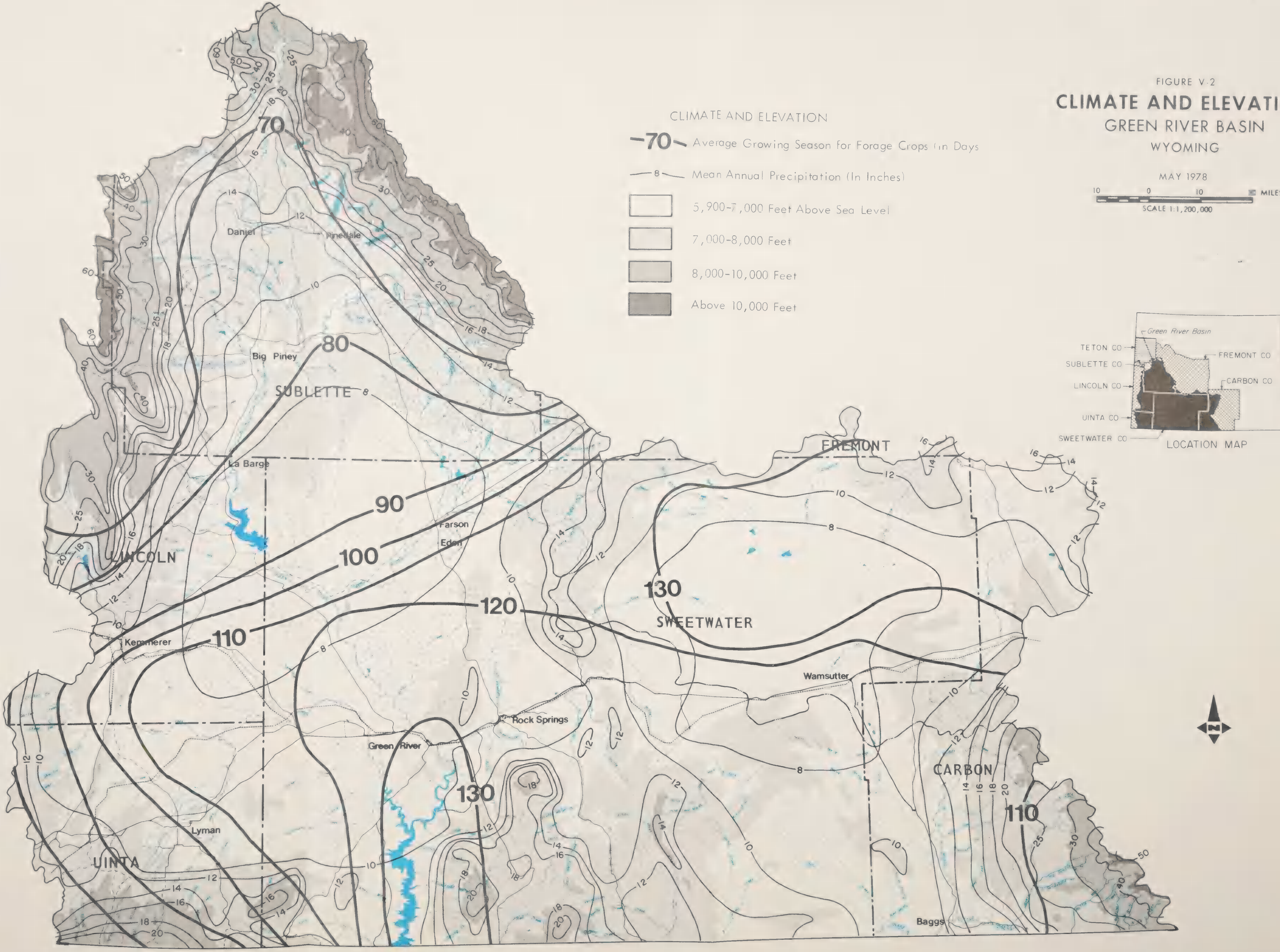
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

M7-ON-22953-5

FIGURE V-2

CLIMATE AND ELEVATION
GREEN RIVER BASIN
WYOMING

MAY 1978



Source:
Base map prepared by SCS,WTSC Carto Unit from USBR 1:1,200,000 Green River Basin Map.
Thematic detail compiled by state staff. Topography by AMS, 1961.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

Cooperative River Basin Studies
State Engineer, Wyoming Water Planning Program

M7-N-22953-13

The Green River, a major tributary to the Colorado River system, is a consequent stream flowing from north to south. With its tributaries, the Green River separates the basin into alternating high, dissected, arid plains and river terraces, and broad, meandering river valleys. As the Green River leaves the state, it flows through the spectacular Flaming Gorge bisecting the eastern end of the Uinta Range. The physiographic features are due largely to the various types of underlying bedrock and the rate at which they have eroded. A panoramic view of the basin would include high, snow-covered mountain peaks surrounding a deeply dissected plain of various erosion terraces, mesas, and badlands.

Green River near Big Piney
Soil Conservation Service

Geology

Geologic features in the basin are separated into four groups: (1) the igneous rocks; (2) steep-dipping sedimentary beds; (3) flat-lying beds; and, (4) unconsolidated deposits (Figure V-3). Igneous rocks are chiefly granite with a few small alkalic intrusive and extrusive rocks. The second group is steeply dipping beds of older, sedimentary rocks. Natural gas, oil, and related minerals, as well as artesian ground water, are associated with these beds. The third group, the flat-lying beds, is younger sedimentary rocks which are important for their trona, oil shale, natural gas, and confined ground water. The

fourth group, unconsolidated deposits, consists of Quaternary alluvium, glacial drift, and wind blown sands. Quaternary deposits are important for sand, gravel, and unconfined ground water.

Oil derrick in Sweetwater County
Soil Conservation Service

Geologic formations consist of rocks of every age from Precambrian to Quaternary with the exception of the Silurian Age. The rock sequence suggests a long geologic period of continuity, with millions of years of geologic records represented. Most of these rocks outcrop along the Wyoming and Gros Ventre Ranges and in the Rock Springs Uplift, and are also encountered beneath the basin floor by deep drilling operations.

Minerals

In 1972 Wyoming ranked 11th in the value of minerals produced in the United States, according to the U.S. Bureau of Mines. Minerals produced in the Green River Basin contributed significantly to this ranking. These minerals are natural gas, natural gas liquids, crude oil, coal, sodium carbonate (trona), sand, and gravel (Figure V-4). Of these minerals, the Green River Basin is noted for one in particular--the unique trona deposits. Additionally, there are large reserves of oil shale.

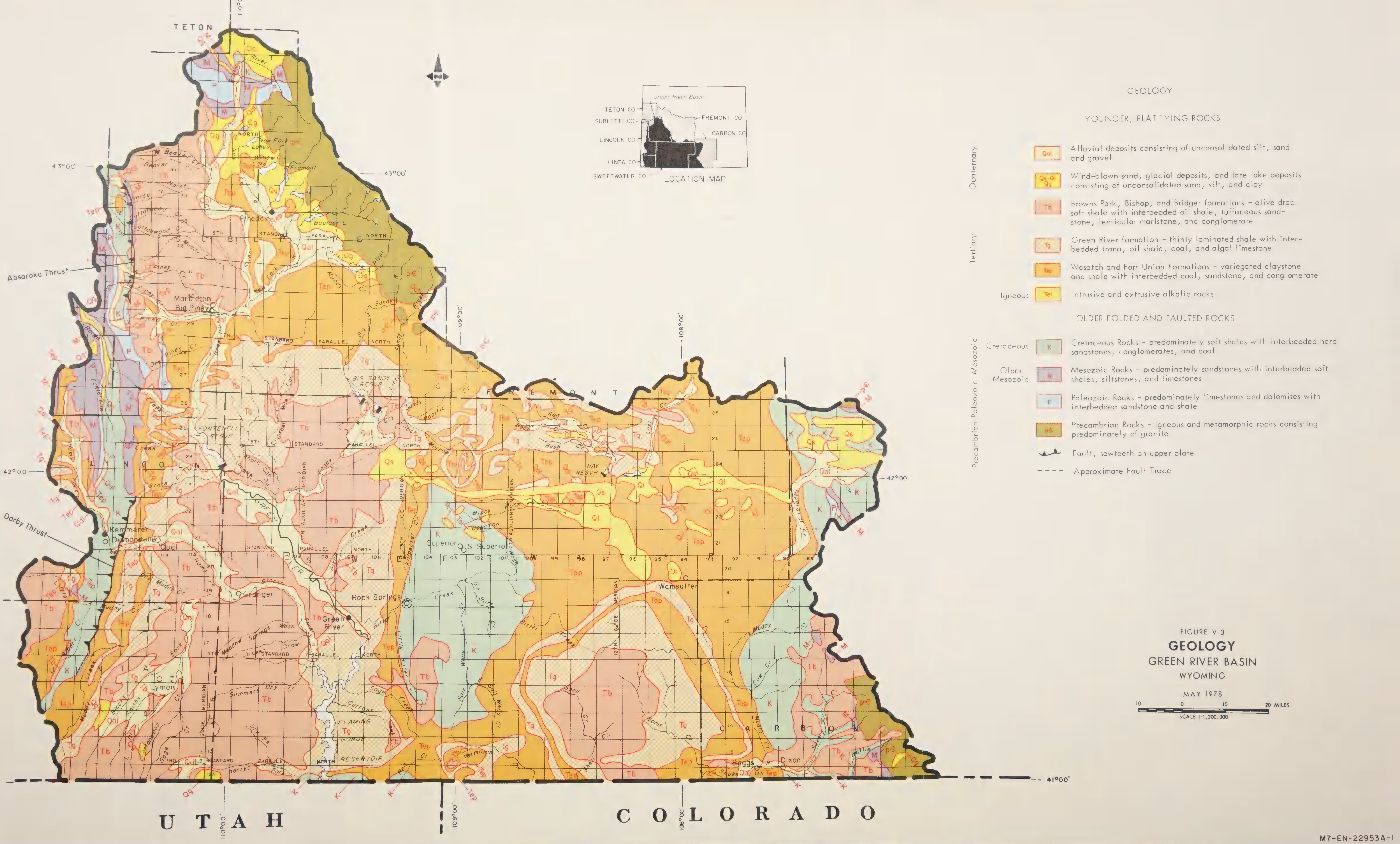
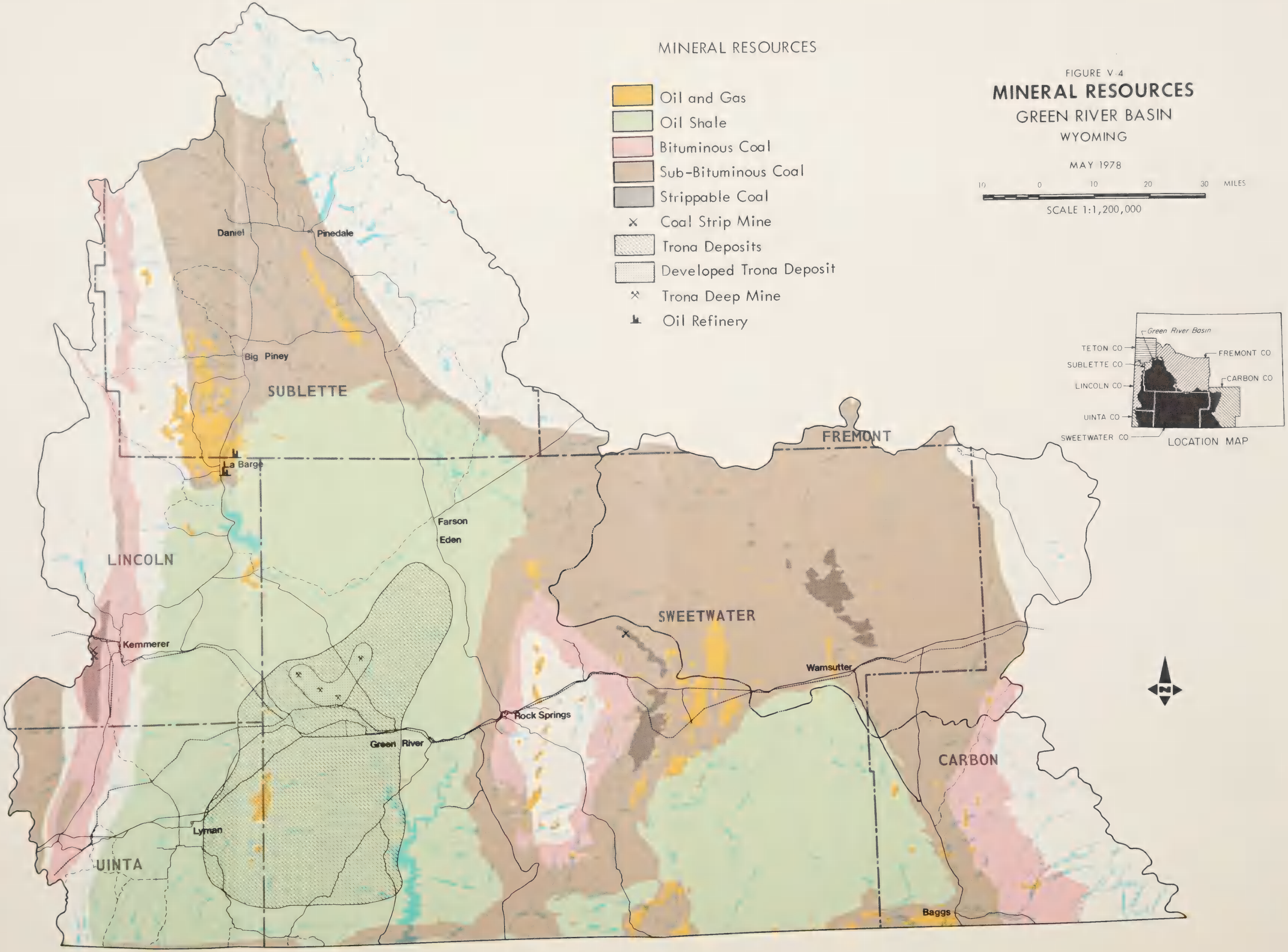


FIGURE V-3
GEOLOGY
GREEN RIVER BASIN
WYOMING
MAY 1978

M7-EN-22953A-1



Source:
Base map prepared by SCS, Portland Carto Unit from Bureau of Reclamation map.
Thematic detail prepared by Bureau of Reclamation.

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USDA-SCS-PORTLAND, OR. 1978

Cooperative River Basin Studies.
State Engineer, Wyoming Water Planning Program.

M7-N-22953-8

Soils

The General Soils Map of the Green River Basin shows 13 main patterns of soils called soil associations (Figure V-5). Each association contains a few major soils and several minor soils and is named for the major soils. The soils in one association may occur in another association but in a different pattern. A more detailed soil survey was completed for the National Forest lands. Copies of the Forest Service soils inventory report are available in local ranger district offices in the basin (35).

Data for the General Soils Map were compiled from field reconnaissances and supplemented by information from geologic maps and completed detailed soil surveys. A description of the map delineations is presented in Table V-1.

The General Soils Map is useful to people who want an overview of the soils for broad uses or comparison purposes, or who want to know the location of large tracts of land suitable for a certain kind of agricultural or non-agricultural land use. Such a map is not suitable for planning the management of a ranch or for selecting the location of roads, buildings, or similar structures.1/

Erosion

There are localized areas where sheet, rill, gully, or streambank erosion are evident. On the irrigated hay and pasturelands, sheet erosion is minor, as the native and introduced forage species protect the soil by their dense stands and sod-forming habits. Nevertheless, there are incidents of accelerated streambank erosion where return flows from irrigated fields enter stream channels. This often results in excessive bank sloughing due to saturated soil conditions. Intensive livestock grazing along the stream bottoms has aggravated this problem by thinning or killing the streambank vegetation.

Streambank erosion in rangeland areas is more severe. An estimated 86 miles of accelerated streambank or gully erosion is evident in the Bitter Creek Watershed and its tributaries. Other areas where gully and streambank erosion are common are: Figure Four, Reardon and Chapel Canyons northeast of LaBarge; Muddy Creek and its tributaries north of Baggs; Ryckman Creek south of Kemmerer; Red Creek near the Colorado state line east of Flaming Gorge; and Muddy and Little Muddy Creeks east and northeast of Evanston; and Little Snake River. There are an estimated 200 miles of gully and streambank erosion that need attention. Often gully and streambank erosion occurs in watersheds where vegetal cover is poor or fair.

The Bureau of Land Management is making extensive inventories of streambank erosion which will be incorporated into their Management

1/ Detailed information on specific soils and uses are available at the district field offices of the Soil Conservation Service and Forest Service.

Table V-1 Description of general soil map symbols, Green River Basin, Wyoming

Map symbol	Description
MC-4	Rock outcrop and very steep, shallow to very deep, well drained soils formed in gravelly to stony loamy material from hard igneous rocks. The area is forested. Principal uses are recreation, livestock grazing, and wildlife habitat.
MC-7	Steep, shallow to very deep, well drained soils formed in gravelly loamy material from mixed hard and soft sedimentary rock and rock outcrop. Much of the area is forested with interspersed parks. Principal uses are logging, recreation, livestock grazing, and wildlife habitat.
MC-8	Rolling to steep, shallow to very deep, well drained soils formed in loamy and clayey material from soft sedimentary rock. Much of the area is grass-shrub with scattered areas of forest. Principal uses are livestock grazing and wildlife habitat.
MC-9	Sloping to steep, very deep, well and excessively well drained soils formed in gravelly, cobbly, and stony glacial outwash and moraines. Much of the area is forest with patches of grass-shrub. principal uses are recreation, livestock grazing, and wildlife habitat.
MC-10	Nearly level to sloping, very deep, well to somewhat poorly drained soils formed in loamy alluvium from granite and quartzite rocks. Much of the area is grass-shrub with patches of grass meadows. Principal uses are livestock grazing and wildlife habitat with some irrigated grass meadows.
MF-3	Sloping to steep, shallow to very deep, well drained soils formed in loamy and clayey material from mixed hard and soft sedimentary rock and rock outcrop. Much of the area is grass-shrub with scattered patches of timber. Principal uses are livestock grazing and wildlife habitat with some irrigated hayland and pasture that may be affected by saline-alkali conditions.
BF-1	Undulating to dune topography, very deep, excessively drained soils formed in wind-laid sands. Vegetation is grass-shrub. Principal uses are livestock grazing, wildlife habitat, and recreation.
BF-5	Nearly level to gently sloping, very deep, well to somewhat poorly drained soils formed in loamy and sandy material on stream terraces and floodplains. Vegetation is grass-shrub. Principal uses are livestock grazing, wildlife habitat, and dryland and irrigated hayland and pasture that may be affected by saline-alkali conditions.
BF-6	Nearly level to undulating, very deep, moderately well to poorly drained, strongly and very strongly alkali-affected soils formed in clayey materials on floodplains, playas, and upland drainageways. Vegetation is grass-shrub. Principal uses are livestock grazing and wildlife habitat.
BF-7	Nearly level to rolling, very deep, well drained soils formed in loamy and loamy over gravelly material on alluvial fans and terraces. Vegetation is grass-shrub. Principal uses are livestock grazing, hayland, and wildlife habitat.
BF-8	Undulating, shallow to very deep, well drained soils formed in loamy materials from soft, calcareous sandstone and rock outcrop. Vegetation is grass-shrub. Principal uses are livestock grazing and wildlife habitat.
BF-10	Gently sloping to steep, shallow to very deep, well drained soils formed in loamy material from soft and hard sedimentary rock. Vegetation is grass-shrub. Principal uses are livestock grazing and wildlife habitat.
BF-13	Nearly level to steeply sloping, very deep, well drained soils formed in loamy material from mixed rocks on uplands and alluvium on playas. Vegetation is grass-shrub. Principal uses are livestock grazing and wildlife habitat.

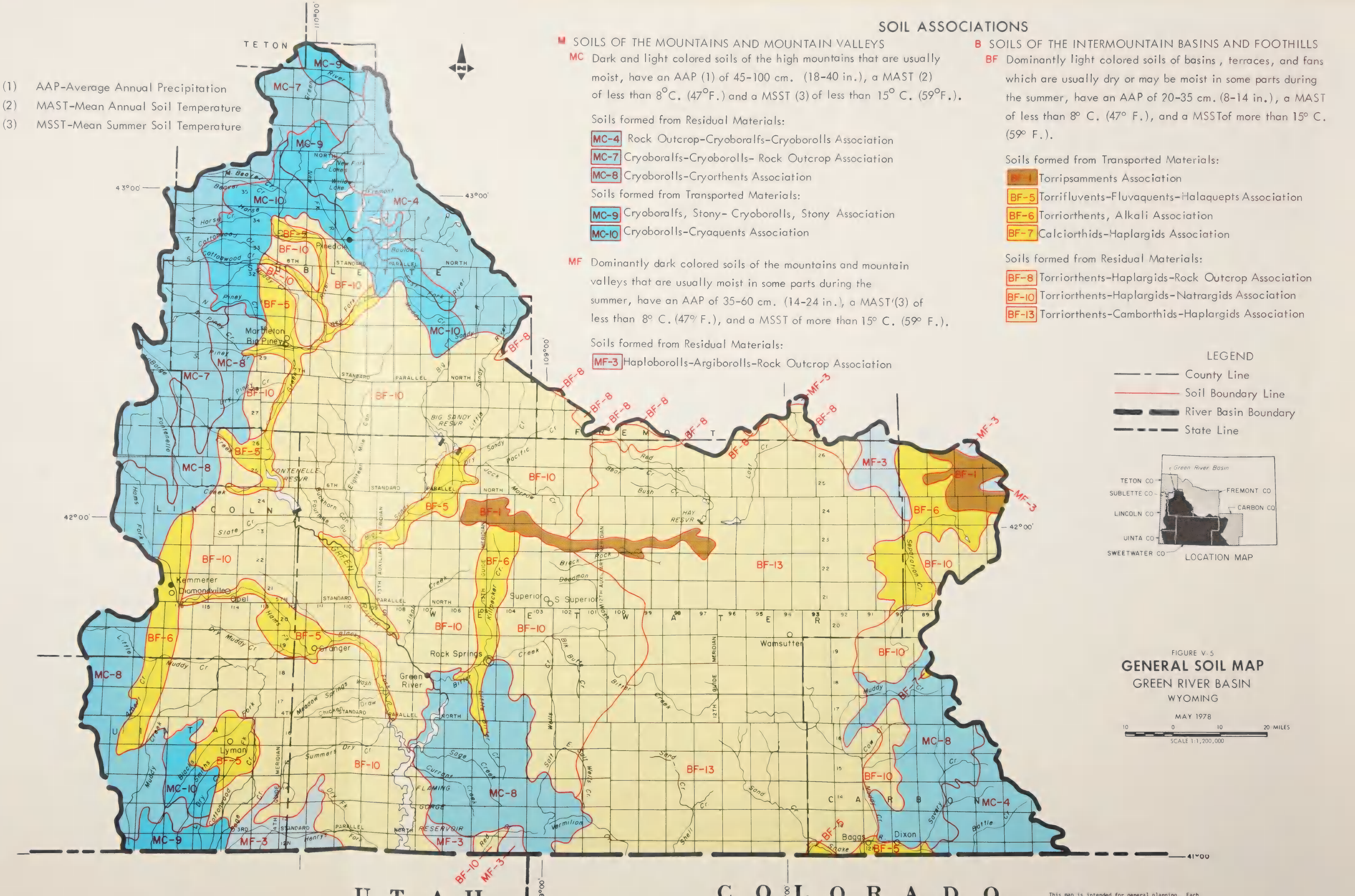


FIGURE V-5
GENERAL SOIL MAP
GREEN RIVER BASIN
WYOMING
MAY 1978

THEMATIC DETAIL PREPARED BY WYOMING STATE STAFF.
BASE MAP PREPARED BY SCS CARTO UNIT FROM USGS 1:1,000,000 NATIONAL ATLAS.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

USDA-SCS-PORTLAND, OR. 1978

M7-EN-22953A

Streambank erosion on Muddy Creek near Baggs
Soil Conservation Service

Framework Plans. 2/ Data pertaining to these efforts have not been accounted for here (31).

Some west side tributaries to Muddy Creek north of Baggs were noted for their past history of accelerated erosion and high sediment yield. Tributaries are Robbers and Little Robbers Gulches, Blue Gap Draw, and Cottonwood Creek. Recent BLM erosion control work has reduced the sediment yield from these watersheds. BLM control efforts consisted to sediment catchment basins, reseeding, contouring waterspreading, and grade stabilization structures.

Average annual erosion rates expressed in tons/acre/year were developed for the basin. Most range, forest, hay and pasture areas have an average annual rate of 0.1 to 0.5 tons/acre/year. Erosion rates on badlands are frequently in excess of 2.0 tons/acre/year.

2/ The Management Framework Plan is a three-step process wherein the basic information from the Unit Resource Analysis and Planning Area Analysis is analyzed and developed into a land management plan.

An estimated 8,522,000 acres of rangeland in the basin have an erosion rate of less than 0.5 tons/acre/year. Conversely, it is estimated 3,124,000 acres of rangeland have an erosion rate above 0.5 tons/acre/year. Figure V-6 is a generalized erosion rate map for the basin.

Vegetation

Vegetation of the basin was mapped into 11 major plant communities. Three other delineations were mapped which include water, rock outcrop, and dunes (Figure V-7). Preliminary aspect types were delineated on Earth Resources Technology Satellite (ERTS) false color infrared imagery at approximately 1:250,000 scale. The imagery covers the period July 7, 1972 to August 6, 1972. Vegetal aspects, as well as the other areas, were field-checked during the summer of 1974 and in the winter of 1974-75. A computer mapping program (COMLUPS) was used to compute acreage (8).

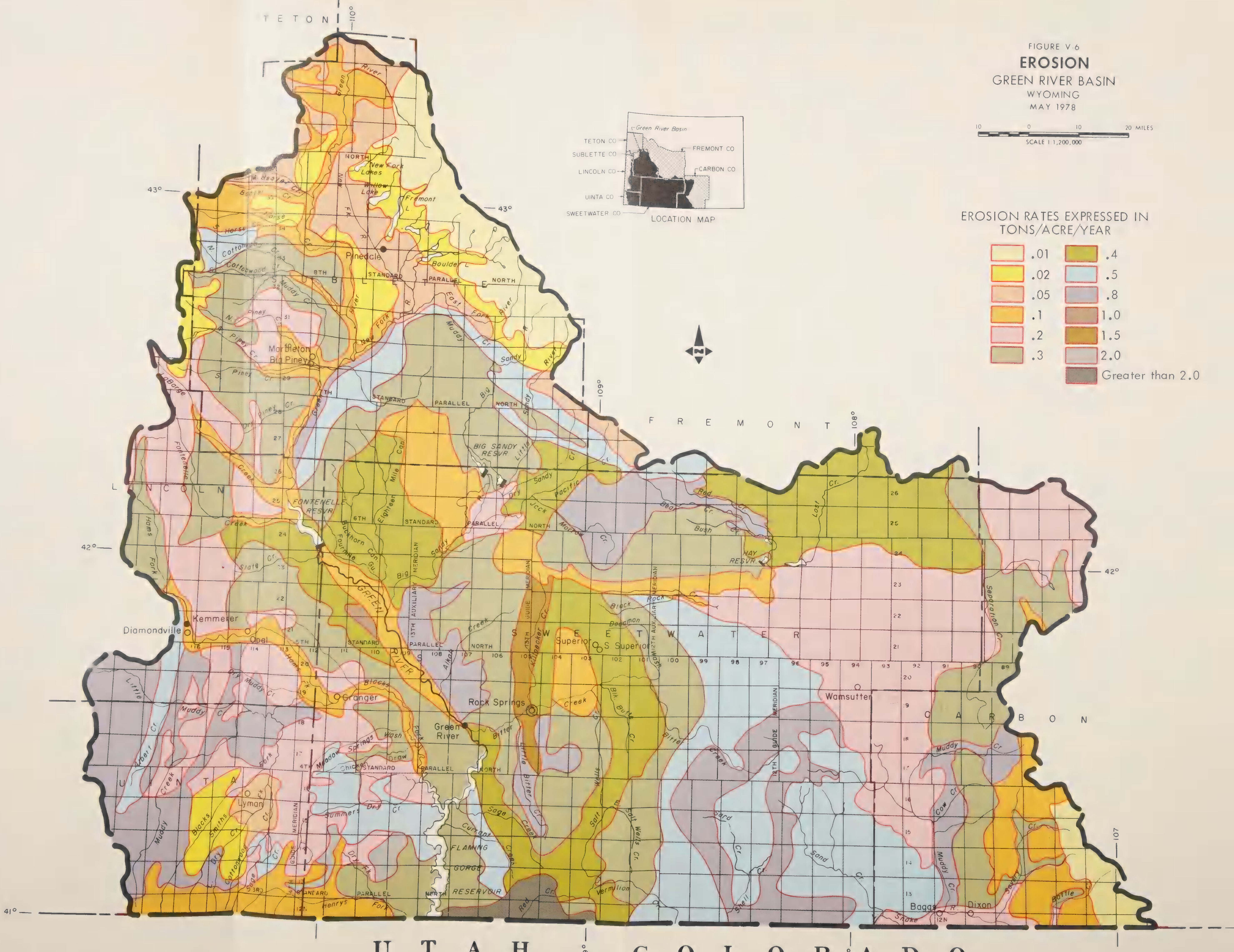
Thirteen of the fourteen aspects were given identification numbers on the map. Cottonwood bottoms were not given a number since the area is too narrow and small for map representation. The plant community aspects consists of the following: halophytic shrub (greasewood-saltbush) (3); shrubgrass (sagebrush-grass) (4); mountain shrub (serviceberry, gooseberry) (5); low shrubgrass (low sagebrush-grass) (13); and phreatophytic shrub (willow bottoms) (14). Forest land aspects include: conifer (fir, pine) (6); juniper (Utah juniper) (9); aspen-birch-oak (10); and alpine (alpine fir) (12). Barren aspects include: rock outcrop (7), and dunes (8). Other aspects are: lakes-playas (2); and meadow-cropland (11). Table V-2 gives the acreage of the aspect types by planning areas and county.

Range Sites

Within each of the generalized aspect groupings, the acreage of range sites by range condition class was determined. As defined by the Soil Conservation Service a range site is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic plant community. Range sites coupled with range condition were used to estimate present and potential forage production. Detailed descriptions of range sites are presented in the Resource Base Working Paper (8). For resource management purposes, the acreages of the sites were determined for each county rather than for the aspect grouping. Fifty-four range sites were identified as occurring in the Green River Basin exclusive of National Forests. The acreage on National Forests that is suitable for use as rangeland is shown in Table V-3. The acreages of major range sites, except for National Forests, are presented in Table V-4.

Range Condition

The Soil Conservation Service has developed four range condition classes representing different levels of departure from what has been defined as the original plant community. The four classes are identified as excellent, good, fair, and poor.



Source:
Base map prepared by SCS, Portland Carto Unit from USGS 1:1,000,000 National Atlas.
Thematic detail compiled by Wyoming State Staff.

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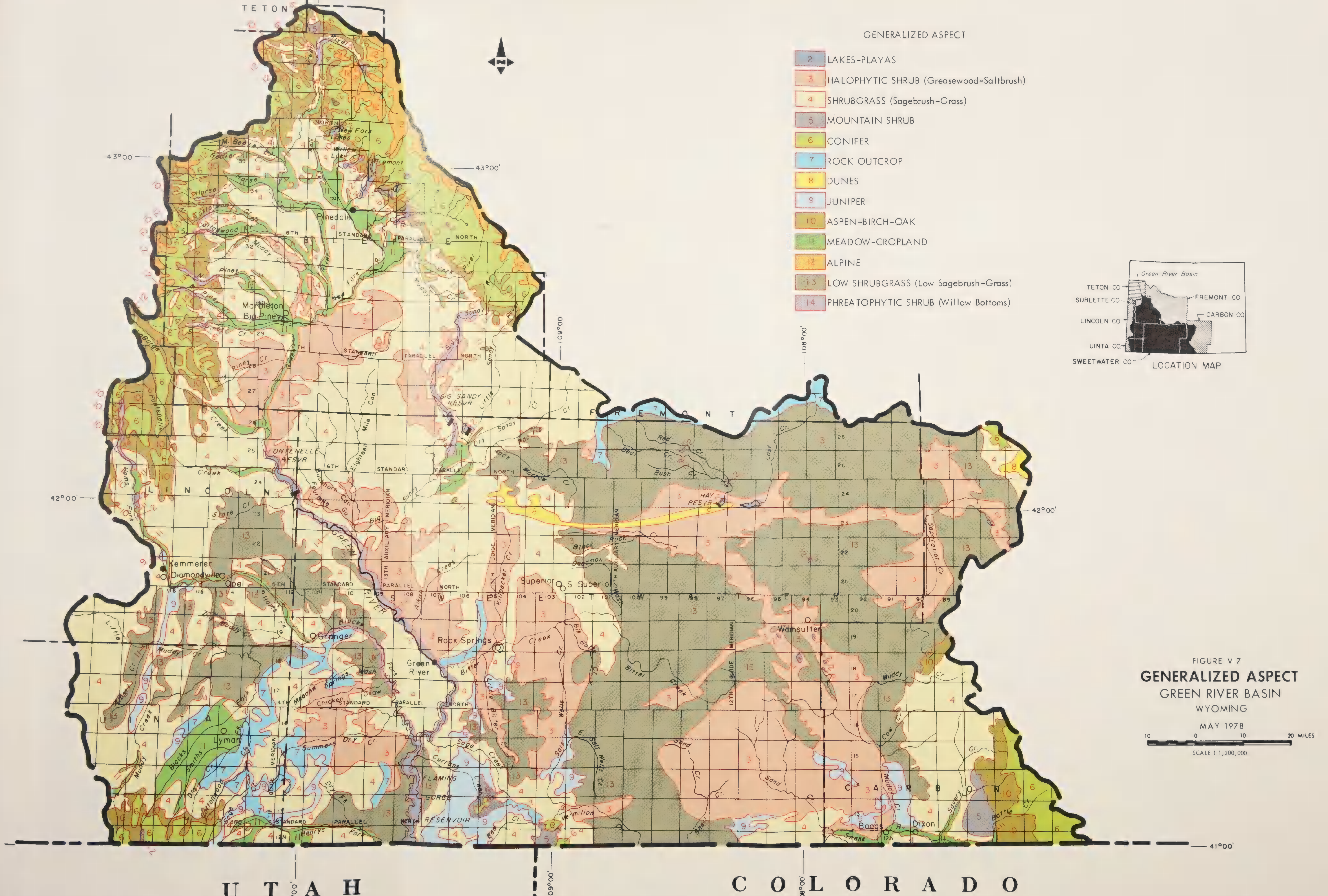


FIGURE V-7
GENERALIZED ASPECT
GREEN RIVER BASIN
WYOMING
MAY 1978

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:1,000,000 Nat. Atlas.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

M7-EN-22953A-4

Sand dunes east of Lamont
Soil Conservation Service

Juniper aspect south of Kemmerer
Soil Conservation Service

Shrub - grass aspect east of Baggs
Soil Conservation Service

Aspen stand in Sierra Madre
Soil Conservation Service

Scrub oak on slopes of Sierra Madre
Soil Conservation Service

Table V-2 Acres of generalized aspect by map number, planning area, and county, Green River Basin, Wyoming

Map number	2	3	4	5	6	7	8	9	10	11	12	13	14	-
Aspects	Lakes playas	Halophytic shrub	Shrub-grass	Mountain brush	Conifer	Rock outcrop	Dunes	Juniper	Aspen-birch-oak	Meadows hayland pasture	Alpine	Low shrub-grass	Phreatophytic shrub	Cottonwood bottoms
PLANNING AREAS:														
Planning Area I														
Teton	200	-	-	400	6,620	-	-	-	4,580	-	-	-	-	-
Sublette	31,130	211,220	761,130	12,200	478,300	2,000	-	-	272,120	268,850	169,890	19,920	57,600	16,440
Lincoln	10,470	41,440	180,410	-	37,600	-	-	-	67,110	21,850	13,380	-	6,240	-
Sweetwater	120	810	2,980	-	-	-	-	-	-	-	-	-	-	90
Subtotal	41,920	253,470	944,520	12,600	522,520	2,000	-	-	343,810	290,700	183,270	19,920	63,840	16,530
Planning Area II														
Sublette	1,480	-	379,640	-	40,100	-	-	-	3,360	7,280	10,360	-	13,830	17,390
Fremont	-	-	59,400	-	-	-	-	-	-	-	-	-	-	-
Sweetwater	15,680	821,220	1,069,820	27,540	8,930	55,500	38,000	157,500	17,180	33,060	-	1,093,760	-	6,870
Lincoln	-	-	1,000	-	-	-	-	-	-	-	-	-	-	100
Subtotal	17,160	821,220	1,509,860	27,540	49,030	55,500	38,000	157,500	20,540	40,340	10,360	1,093,760	13,830	34,360
Planning Area III														
Lincoln	2,220	-	475,780	-	44,140	-	-	15,140	62,270	23,340	-	232,080	17,930	-
Sweetwater	23,760	364,700	306,520	-	-	27,000	-	15,560	-	17,790	-	221,280	7,880	21,370
Uinta	1,160	-	527,650	-	55,200	3,000	-	43,280	52,600	113,790	-	179,150	4,010	-
Subtotal	27,140	364,700	1,309,950	-	99,340	30,000	-	73,980	114,870	154,920	-	632,510	29,820	21,370
Planning Area IV														
Fremont	-	5,350	-	-	-	3,500	-	-	-	-	-	74,250	-	-
Sweetwater	7,780	449,960	34,360	-	14,930	48,370	40,000	-	-	-	-	1,361,240	-	-
Carbon	1,390	130,070	-	-	-	-	4,000	-	-	-	-	324,900	-	-
Subtotal	9,170	585,380	34,360	-	14,930	51,870	44,000	-	-	-	-	1,760,390	-	-
Planning Area V														
Sweetwater	860	328,550	52,480	-	-	-	-	19,190	-	-	-	105,280	-	-
Carbon	-	178,930	360,210	15,000	112,040	28,000	-	56,170	83,000	27,790	-	119,750	1,740	10,710
Subtotal	860	507,480	412,690	15,000	112,040	28,000	-	75,360	83,000	27,790	-	225,030	1,740	10,710
TOTAL	96,250 1/	2,532,250	4,211,380	55,140	797,860	167,370	82,000	306,840	562,220	513,750	193,630	3,731,610	109,230	72,970

1/ Contains 12,880 acres of intermittent lakes and playas in Sweetwater and Carbon Counties.

Table V-3 Range suitability and condition on National Forests, Green River Basin, Wyoming

Planning area and county	Suitable range: Used	Suitable range: Not used	Unsuitable or non-range	Range condition of suitable range: Excellent	Good	Fair	Poor	Very poor
	acres							
AREA I								
Teton	4,618	0	7,182	554	1,709	1,986	323	46
Sublette	331,622	10,146	381,552	29,227	146,093	143,084	16,164	7,198
Sweetwater	(No National Forest in Sweetwater County in this area)							
Lincoln	42,700	674	44,406	920	17,421	23,251	625	1,159
Subtotal	378,940	10,820	433,140	30,701	165,223	168,321	17,112	8,403
AREA II								
Fremont	(No National Forest in this county in this area)							
Lincoln	(No National Forest in this county in this area)							
Sublette	25,910	1,137	15,653	3,246	10,007	11,630	1,893	271
Sweetwater	(Livestock use on Flaming Gorge N.R.A. administered by BLM)							
Subtotal	25,910	1,137	15,653	3,246	10,007	11,630	1,893	271
AREA III								
Lincoln	39,455	286	35,039	397	9,538	28,614	795	397
Sweetwater	(Livestock use on Flaming Gorge N.R.A. administered by BLM)							
Uinta	24,788	1,413	11,559	806	14,306	9,417	1,094	578
Subtotal	64,243	1,699	46,598	1,203	23,844	38,031	1,889	975
AREA IV	(No National Forest lands in Area IV)							
AREA V								
Carbon	90,128	0	97,192	0	4,441	52,500	27,069	6,118
Sweetwater	(No National Forest lands in this county in this area)							
Subtotal	90,128	0	97,192	0	4,441	52,500	27,069	6,118
BASIN TOTALS	559,221	13,656	592,583	35,150	203,515	270,482	47,963	15,767

Source: U. S. Forest Service

Table V-4 Acres of range sites by counties, Green River Basin, Wyoming

Range site	Carbon	Lincoln	Sublette	Fremont Sweetwater	Uinta	Total acres	Percent
Clayey	21,700	58,700	66,900	116,800	17,600	281,700	2.5
Coarse Upland	17,500	-	17,000	48,700	59,400	142,600	1.3
Dense Clay	14,600	-	16,200	102,300	13,700	146,800	1.3
Gravel	8,000	47,100	42,200	4,400	1,000	102,700	.9
Loamy	197,600	298,000	411,000	1,348,700	245,500	2,500,800	22.3
Impervious Clay	-	-	-	2,700	-	2,700	T
Overflow	1,100	1,500	18,800	6,800	1,100	29,300	.3
Saline Lowland	8,700	1,100	22,300	270,600	12,200	314,900	2.8
Saline Subirrigated	3,000	600	18,200	3,700	2,700	28,200	.2
Saline Upland	226,500	69,500	138,400	1,323,500	106,400	1,864,300	16.6
Sandy	51,900	68,900	162,100	623,500	76,900	983,300	8.7
Sands	48,700	5,700	13,700	65,600	9,800	143,500	1.3
Shale	3,300	58,200	13,600	111,500	16,600	203,200	1.8
Shallow Breaks	1,700	-	5,800	200,800	13,300	221,600	2.0
Shallow Clay	20,400	232,700	1,200	177,900	10,300	442,500	3.9
Shallow Loamy	324,200	94,800	274,000	1,631,800	203,100	2,527,900	22.5
Shallow Sandy	14,600	11,600	7,700	-	-	33,900	.3
Steep Loamy	156,800	2,500	130,200	276,400	-	565,900	5.0
Subirrigated	3,500	6,600	55,000	-	10,300	75,400	.7
Very Shallow	57,900	65,000	96,800	75,700	35,000	330,400	2.9
Wetland	1,800	600	21,500	90,800	14,700	129,400	1.1
Woodland	80,400	500	72,100	-	7,300	160,300	1.4
Totals	1,263,900	1,023,600	1,604,700	6,482,200	856,900	11,231,300	100.0

Range condition is the present state of vegetation of a range site in relation to the climax (natural potential) plant community for that site. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble that of the climax plant community for the site. Range condition is basically an ecological rating of the plant community. Air-dry weight is the unit of measure used in comparing the composition and production of the present plant community with that of the climax community. Plant communities can change with overuse by domestic livestock or wildlife, and by drought or fire. This change can result in the disappearance of the more desirable forage plants and the increase of less desirable plant species.

The Forest Service has developed a range condition classification system using five categories. The first four categories are the same as those used by SCS, but a fifth category called "very poor" has been added. See Table V-3 for the classification of range condition on the National Forest lands.

The Bureau of Land Management does not use a range condition class rating system in evaluating their rangelands. However, they have developed other methods which provide satisfactory answers to problems related to forage production and stocking rates.

Using information from the three agencies, rangeland was classified into three broad condition groups: excellent and good, fair, and poor, by range sites. Range condition groups as presented here are an expression of the degree to which the present plant composition, expressed percent, has departed from that of the climax plant community. The percent departure from climax community for the various condition groups is given below:

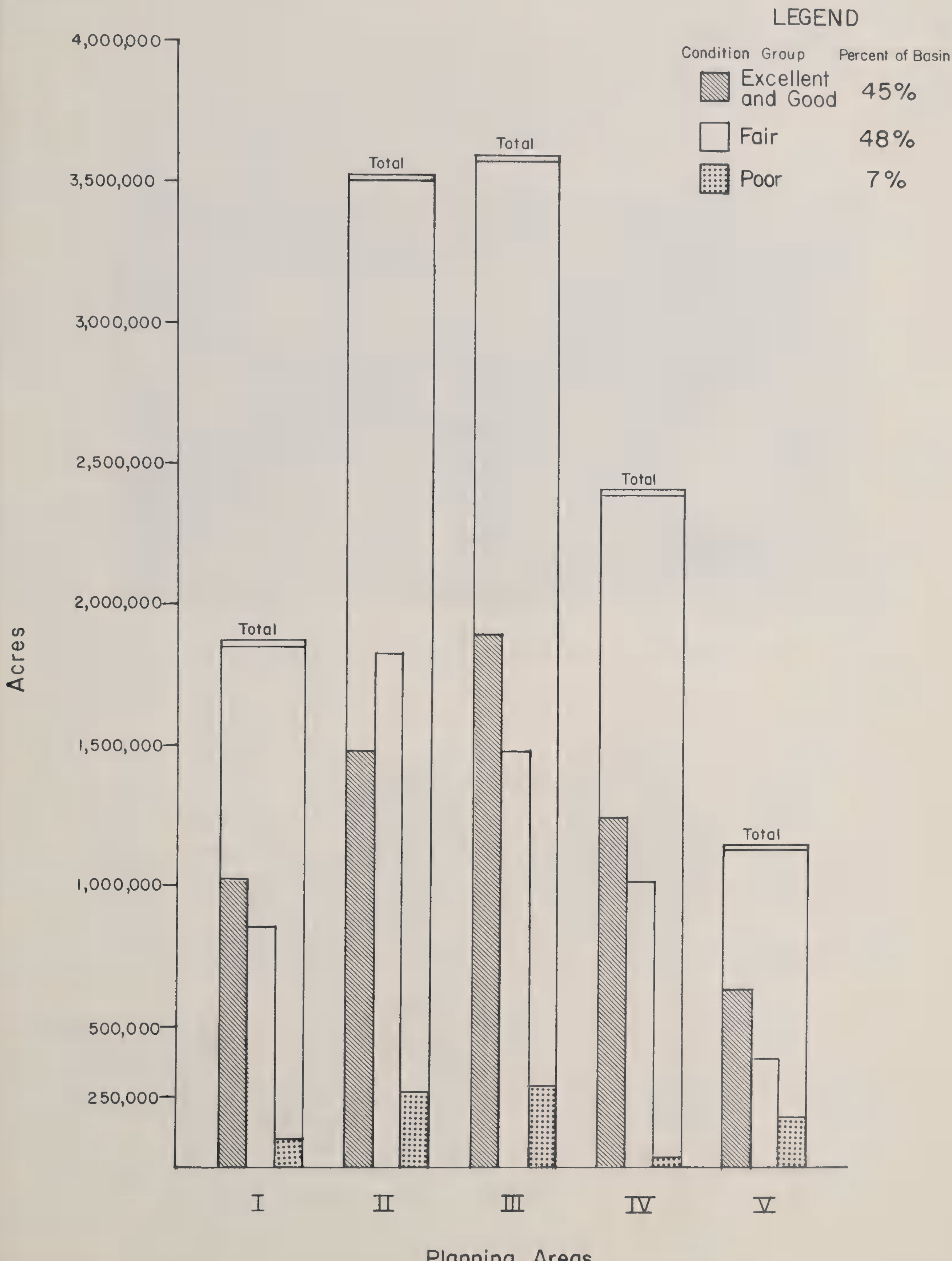
Condition group	Percent departure from climax plant community
Excellent & Good	0-49
Fair	50-74
Poor	74-100

Figure V-8 shows the estimated acreages of excellent and good, fair, and poor condition rangeland by planning areas. Approximately 7 percent of the range is in poor condition, 48 percent is in fair condition, and 45 percent is in excellent and good condition (2).

FIGURE V-9 Generalized Range Condition

(MAP HAS BEEN DELETED)

Figure V-8 Range Condition, Green River Basin, Wyoming



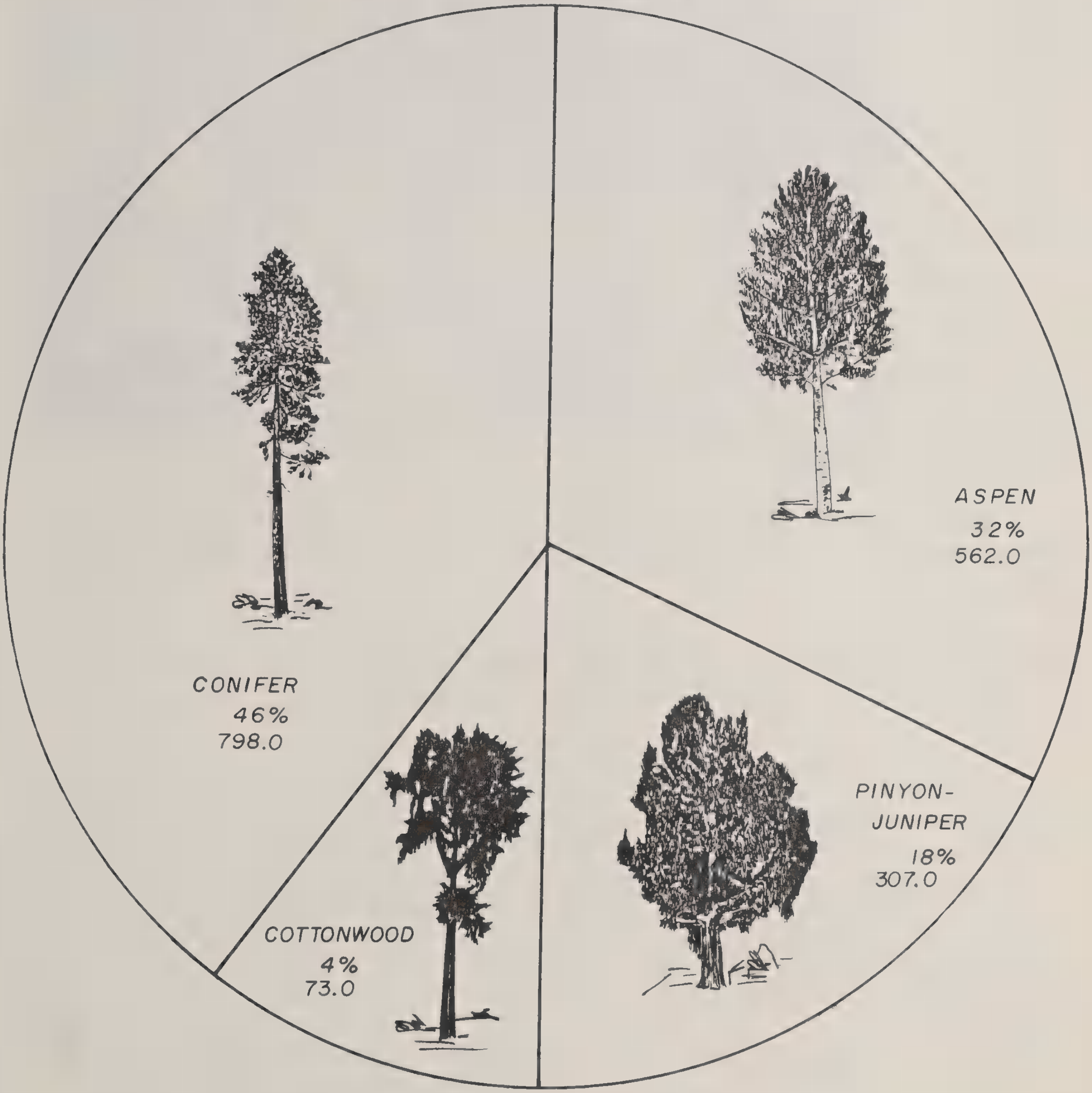
Poor condition low shrub - grass range near Farson
Soil Conservation Service

Forest Land Condition and Production

There are an estimated 1,739,900 acres of forest land in the basin. Thirteen percent of the total basin area is forest land. Ninety-one percent of this acreage is under multiple use management by the Forest Service and Bureau of Land Management. Seven percent of the remaining acres is privately-owned and two percent is state-owned. State and private forest lands are the management concern of the Wyoming State Forester.

Commercial forest lands account for 542,400 acres or 31 percent of the total forested acres. Another 104,500 acres, six percent, are classified as productive non-commercial (land legally or administratively withdrawn from timber utilization). The remaining 1,093,000 acres, 63 percent, are used primarily for forage, watershed protection, wildlife habitat, wilderness areas, and esthetics. Forest cover types include conifer, aspen, cottonwood, and pinyon-juniper (5). Figure V-10 presents the percent composition of the major forest types.

Figure V-10 Forest cover types, Green River Basin, Wyoming
(Percent and thousands of acres)



Conifer and aspen constitute the more important commercial harvest potential. Forest industries occasionally harvest cottonwood. Cottonwood is mainly valued as wildlife habitat, streambank stabilizer, and streamside landscape. Industry and residents occasionally harvest juniper fence posts and pinyon Christmas trees. This forest cover is also valued more as wildlife habitat.

Conifer and aspen cover types are considered usable for commercial production while cottonwood and pinyon-juniper generally are not. Of 1,360,100 conifer and aspen acres, 542,400 acres are classified as commercial forest and 104,500 acres are classified as reserved productive and noncommercial forest.3/ About 713,200 acres, or 52 percent, are classified as noncommercial forest.

Commercial forest land ownerships are 63 percent National Forest, 20 percent Bureau of Land Management, three percent state, and 14 percent private. Commercial forest land in the basin constitutes 12.6 percent of the commercial forest land in the state of Wyoming.

Several important tree species occur in the conifer and aspen forest cover types. Each species, its area, and volume proportions are shown in Table V-5.

Table V-5 Tree species by percent of area and volume of commercial timber, Green River Basin, Wyoming

Species	Area	Volume: Growing stock	Volume: Sawtimber
	--------------Percent	--------------	
Lodgepole pine	51	44	43
Englemann spruce, Alpine fir	33	46	47
Douglas fir	9	6	9
Aspen	7	4	1
	100	100	100

3/ Commercial forest land is defined as forest land presently or prospectively suitable and available for timber growing and produces 20 cubic feet or more of wood fiber per acre per year.

Commercial forest land on lower slopes of Wyoming Range
Soil Conservation Service

Most firms that harvest and process basin timber are located in adjoining river basins. Small local sawmills and basin residents harvest and use minor amounts of sawtimber, poles, posts, and firewood for home, farm, and commercial use.

Timber stands in the basin are characterized by slow growth and relatively low site quality.4/ Site class information is not available on a county basis, but an inference can be drawn from statewide data.5/ An estimated 22 percent of Wyoming's forests can produce 50 or more cubic feet of wood fiber per acre per year, and 78 percent can produce between 20 and 49 cubic feet of wood fiber per acre per year. In addition, much of the accessible old growth sawtimber has been harvested in the last 30 years or so. Young and small stands now occupy

4/ Site quality: A loosely used term denoting the relative productivity of a site for a particular tree species.

5/ Site class: A quantitative classification of forest land in terms of inherent capacity to grow crops of industrial wood. The classification is based upon mean annual growth of growing stock (not including thinnings) attainable in fully stocked stands at the peak or culmination of mean annual growth. Height-age relationships are used as indicators of the specific volume-site class. Mean annual growth or volume is expresed in terms of cubic feet of wood fiber per acre per year.

these sites. The assumption is made that 20 percent of the Green River Basin's forest lands have potential to produce 50 or more cubic feet per acre per year.

Several conditions have contributed to an abundance of dead and dying timber on basin forest lands. Lodgepole pine occupies much of the forested lower slopes. Lodgepole pine stands were "tie hacked" in the late 19th and early 20th century for railroad ties. Stands were opened and dwarf mistletoe infection increased and spread which in turn slowed growth and contributed to early mortality. Mountain pine beetle infestations have also ravaged lodgepole pine stands. Windfall and deadfall timber from disease and insect kill are prevalent in some areas. The eastern toe slopes of the Wyoming range are an example. Downed timber lies 4 to 6 feet deep in some lodgepole pine stands. Small-sized timber stands have resulted from past harvest and mortality factors. Additionally, thinning and intermediate harvest are not extensively employed on federal, state, and private lands.

Water Resources

Water Rights

Provisions of the Wyoming Constitution declare water to be State property, allow for the appropriation of water for beneficial uses, and establish the Office of the State Engineer and the Board of Control to supervise such appropriations. Priority of appropriation--"first in time is first in right"--is the basis for Wyoming water law.

The Resource Base Working Paper (8) lists the major reservoirs and the major direct flow appropriations in the Green River Basin for which either an application for a permit has been filed with the State Engineer, or for which a permit has been granted. The 12 major reservoir filings are for 3,615,997 acre-feet of storage, of which 345,397 acre-feet are for a change in status of existing storage in Fontenelle Reservoir. There are 22 filings for major direct flow appropriations totaling 9,509 cfs.

There are about 537,000 acres in the basin with valid irrigation rights, but the acreage actually irrigated is estimated to be 336,100 acres. The discrepancy between water rights acreage and acres actually irrigated is common throughout the state and is due to improper descriptions of lands to be irrigated or to acreages actually being unsuitable for irrigation because of inadequate water supply to fill the rights, difficult delivery situations, or poor soils.

Available Water Supplies

The Colorado River Compact of 1922 divided the beneficial uses of water in the Colorado River between the Upper Basin (those portions of the states of Wyoming, Colorado, New Mexico, Utah, and Arizona which drain into the Colorado River system above Lee Ferry, Arizona) and the lower basin (those portions of the states of Arizona, California,

Nevada, New Mexico, and Utah which drain into the Colorado River system below Lees Ferry). Each of the basins was allocated the beneficial consumptive use of 7.5 million acre-feet of water annually.

Total annual average water yield for the portion of the Green River Basin in Wyoming, calculated from the 1930-1973 period, is 1,866,900 acre-feet. To this yield must be added 379,300 acre-feet entering Wyoming from other states, which then brings the yield to 2,246,200 acre-feet. The water yield and depletions are presented in Figure V-11. Outflow of the Green River from Wyoming is given as 1,542,200 acre-feet. This does not account for 73,000 acre-feet which is Wyoming's portion of the Colorado River Storage Project Evaporation (CRSP).

Details of all compacts are in the Resource Base Working Paper (8). Table V-6 presents three water supply interpretations showing Wyoming's share under each condition.

Groundwater

There are numerous aquifers in the basin. Wells in shallow aquifers (depths to 300 feet below the surface) generally yield less than 20 gallons per minute (gpm) of poor to good quality water. The concentration of total dissolved solids (TDS) ranges from 250 to 2,800 mg/l. Exceptional yields as high as 2,000 gpm are reported from alluvial sands and gravels. Terrace gravels reportedly may yield 2,000 gpm. Yields from shallow consolidated sandstones and conglomerates vary from less than 90 gpm to more than 200 gpm.

Deeper wells into consolidated aquifers produce moderate to large yields. However, the potential yield at any specific well site is unpredictable. The main body of the Wasatch formation may yield 700 gpm to wells which penetrate a sufficient saturated thickness of the formation. Likewise, the Battle Spring formation in the Great Divide Basin may produce a maximum yield of 7,000 gpm to wells which penetrate the entire formation thickness. Generally, the older formations which are buried deeper yield water of inferior quality (Figure V-12).

Wildlife

Wildlife habitat in the Green River Basin supports a wide variety of mammals, birds, amphibians, and reptiles. Extensive habitat is available for many species such as elk, mule deer, and antelope, in the high plains desert and peripheral mountain ranges (4,10) (Table V-7).

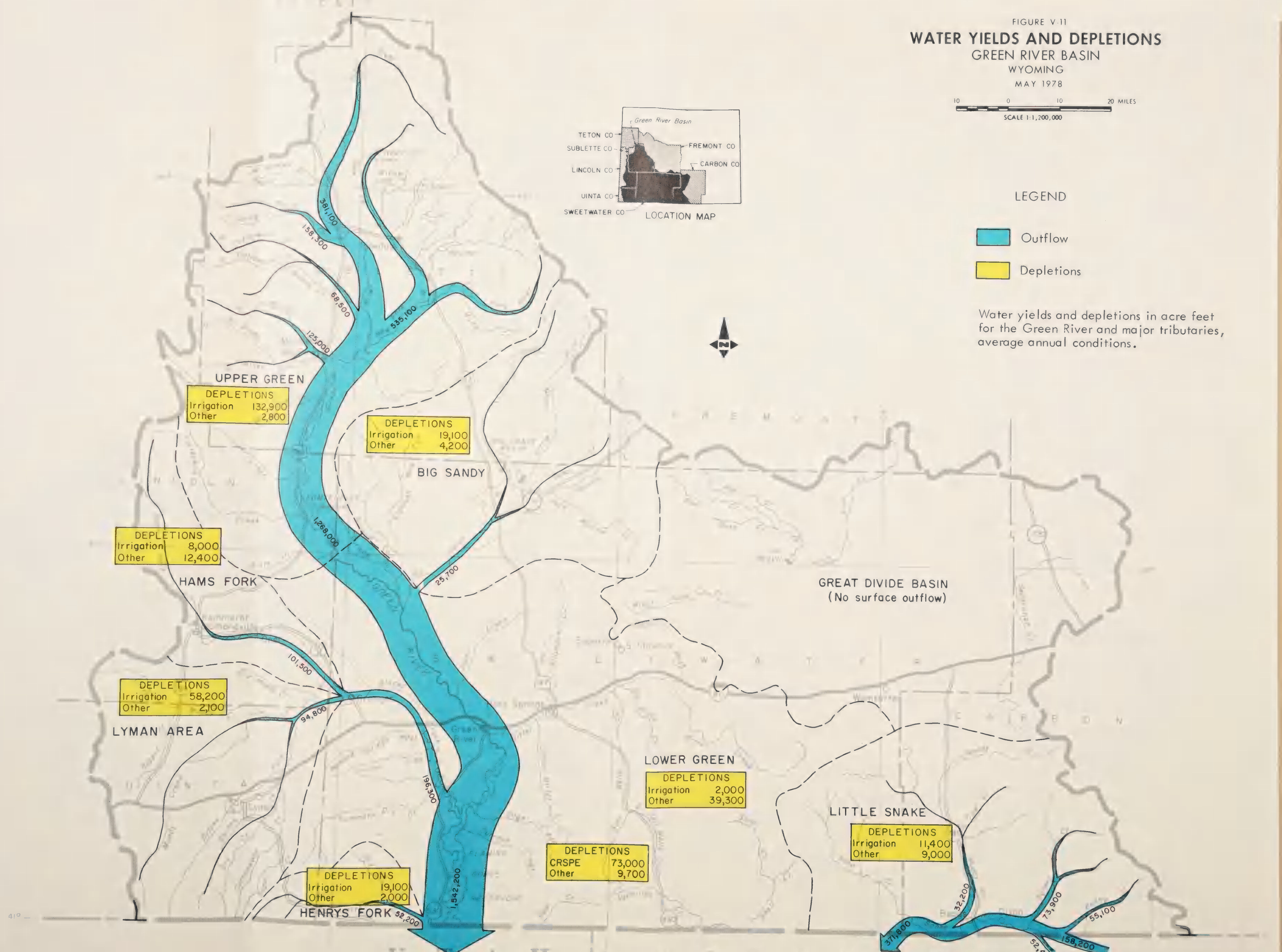
Big Game

Big game mammals are mule deer, elk, antelope, moose, Rocky Mountain bighorn sheep, and white-tailed deer. Mule deer forage the widest of the big game animals and occur throughout the Green River Basin on seasonal ranges or along traditional migration routes at various times throughout the year (Figure V-13).

Table V-6 Estimates of Wyoming's Colorado River Compact water supply[1/], Green River Basin, Wyoming

	Acre-Feet per Year
I. State of Wyoming	
A. Based upon Article III (a) of the Colorado River Compact and the Upper Colorado River Compact:	
Upper Basin Supply	7,500,000
Arizona Upper Basin Share	50,000
	7,450,000
Wyoming's 14% share (salvage neglected)	1,043,000
B. Based upon R. J. Tipton's <u>Development of Presently Unused Water Supplies of the Green River Basin in Wyoming</u>, October, 1972, Tipton and Kalmbach (15). Water supply estimate and Article III (d) delivery requirements of 75,000,000 acre-feet each consecutive 10-year period:	
Upper Basin Supply	6,300,000
Arizona Upper Basin Share	50,000
	6,250,000
Wyoming's 14% share (salvage neglected)	875,000
The Mexican Treaty delivery has not been calculated. The Upper Basin has not agreed with the accounting of Lower Basin uses, losses, and tributary water flows and uses. PL 90-537 (Colorado River Basin Project Act, Section 202, 1968) declares the Mexican Treaty water deliveries to be a national obligation.	
II. U.S.B.R. - Most severe water supply hypothesis	
A. Based on the assumption that the Upper Basin must deliver 750,000 acre-feet per year to Mexico under Article III (c) plus the delivery required by Article III (d).	
Upper Basin Supply	5,800,000
Arizona Upper Basin Share	50,000
	5,750,000
Wyoming's 14% Share	805,000
Salvage (reduction in channel losses)	31,000
Relief from Mexican Treaty	105,000
	941,000

1/ Source - Wyoming Water Planning Program



Source:
Base map prepared by SCS, Portland Carto Unit from USGS 1:1,000,000 National Atlas.
Thematic detail compiled by Wyoming State Staff.

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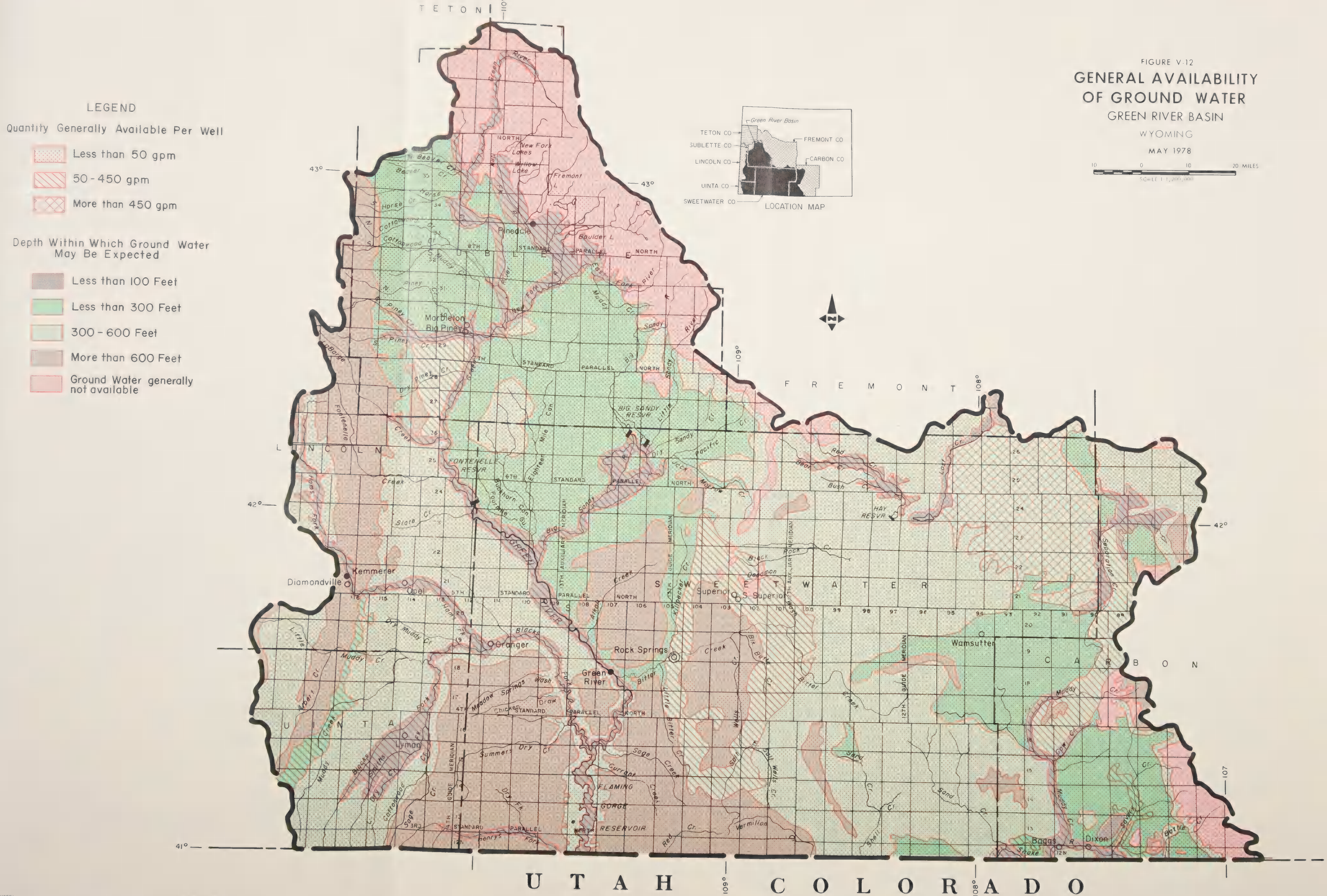

FIGURE V-12
GENERAL AVAILABILITY OF GROUND WATER
GREEN RIVER BASIN
WYOMING
MAY 1978

Source:
Base map prepared by SCS, Portland Carto Unit from USGS 1:1,000,000 National Atlas.
Thematic detail compiled by Wyoming State Staff.

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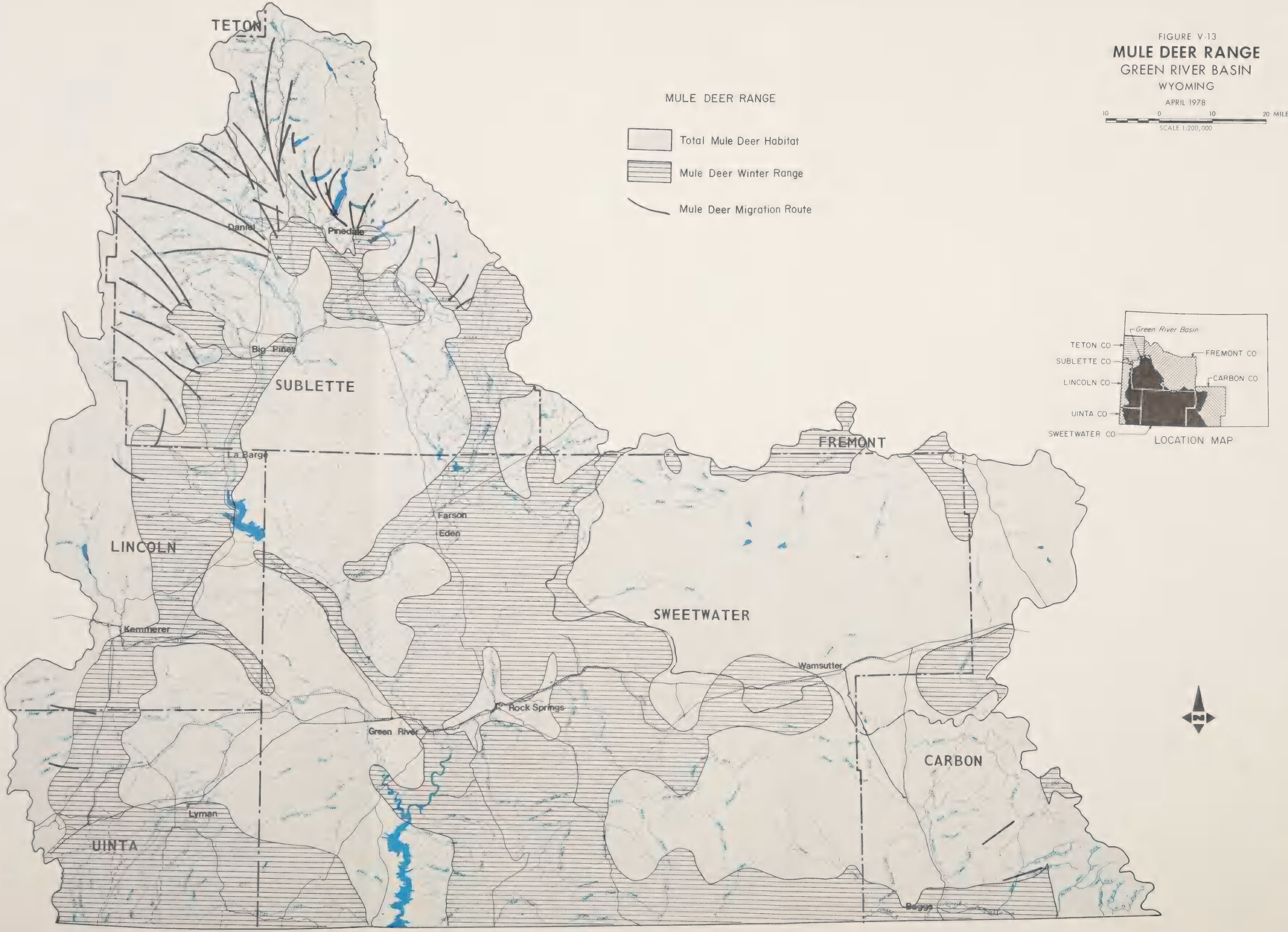
FIGURE V-13

MULE DEER RANGE

GREEN RIVER BASIN

WYOMING

APRIL 1978



Source:
Prepared by SCS, WTSC Carto Staff from Sublette Investigation MOP Team Cooperative River Basin Survey Map, 1:500,000.

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USDA-SCS-PORTLAND, OR. 1978

Cooperative River Basin Studies
State Engineer, Wyoming Water Planning Program

M7-N-22953-15

Table V-7 Wildlife species, species importance, and habitat areas, Green River Basin, Wyoming

Species	Specie 8/ Importance	Habitat Area (Acres or Location)	Species	Specie 8/ Importance	Habitat Area (Acres or Location)
Mule deer	R	Entire basin 1/	Striped skunk	L	9,093,100
Elk	N	Generally elevations above 6,500' 2/	Spotted skunk	L	2,305,300
			Long-tailed weasel	L	576,000
Antelope	R	11,804,000 3/	Short-tailed weasel	L	246,240
Moose	I	5,768,500 4/	White-tailed jackrabbit	L	11,640,000
Bighorn sheep	N	7,000	Porcupine	L	2,231,600
White-tailed deer	L	234,920 5/	River otter	S	Rivers and streams
Black bear	R	700,000	Lynx	N	750,000
Grizzly bear	N	500,000	Wolverine	N	500,000
Mountain lion	L	Entire basin	Pika	S	193,600
Cottontail rabbits	L	11,500,000	Geese	L	750,000
Snowshoe hares	L	1,100,000	Ducks	L	3,190,000
Red squirrel	L	1,100,000	Mourning dove	L	11,500,000
Beaver	L	1,300,000 6/	Common snipe	L	1,140,000
Mink	L	1,300,000	Virginia rail	L	1,140,000
Muskrat	L	551,000	Sandhill crane	N	1,140,000
Marter	N	1,100,000	Sage grouse	I	11,290,000 7/
Badger	L	--	Ruffed grouse	L	1,810,000
Coyote	L	Entire basin	Blue grouse	L	1,950,000
Red fox	L	10,382,400	Columbian sharp-tailed grouse	S	380,000
Swift fox	L	10,015,200	White-tailed ptarmigan	L	200,000
Bobcat	L	Entire basin	Ring-necked pheasant	L	40,000
Racoon	L	296,300			
Ringtail	L	One locality near Kemmerer	Chukar	L	1,140,000

1/ Limiting habitat is 1,030,000 acres of critical winter range (SOURCE: Wyoming Game and Fish)
2/ Limiting habitat is 76,000 acres of critical winter range
3/ Limiting habitat is 1,762,000 acres of critical winter range
4/ Limiting habitat is 328,000 acres of critical winter range
5/ Baggs and Sandstone Watersheds
6/ Limiting habitat is 744,400 acres of aspen-birch, cottonwood bottoms and phreatophytic shrubs
7/ Limiting habitat is estimated at 200 breeding areas
8/ Local(L), Regional (R), State (S), National (N), International (I)

Shiras bull moose during rutting season
Wyoming Game and Fish Commission

Bull elk on winter range
Wyoming Game and Fish Commission

White-tailed deer are limited in numbers and distribution in the basin. Only one small herd is known, and it inhabits range and forested land along the Little Snake River in the Baggs area.

Elk are an important big game species in the Green River Basin. Herds of elk graze extensively in the alpine, subalpine, and montane habitat types of the basin. Uniquely, one herd inhabits desert lands in the Steamboat Mountain area in north-central Sweetwater County (Figure V-14).

Shiras moose are located in willow bottoms and forested land (Figure V-15). The base population of 3,640 moose is one of the largest in the world.

Antelope inhabit much of the sagebrush-grass, greasewood-saltbrush, and low sagebrush habitat types (Figure V-16). Compared to other western states, population densities are greater in the basin. Bighorn sheep occur in the Wind River Mountains on about 7,000 acres of alpine and montane habitat types.

Black bears and mountain lions are relatively few in number. These animals inhabit the mountainous areas within the basin. Reliable sighting and an occasional harvest support this fact. Grizzly bears were last sighted 10 years ago in the Jim Bridger Wilderness Area.

Wild and Free Roaming Horses

The Green River Basin has a population of wild and free roaming horses estimated to be about 6,000 head. These horses currently occupy about 3,600,000 acres of high plains desert range. Of great concern is competition for forage among horses, domestic livestock, big game animals, and non-game wildlife.

Wild horses north of Rock Springs
Bureau of Land Management

Protection under the Wild Horses and Burro Act, P.L. 92-195, December 1971, is afforded these horses. Under protection of this act, horses have increased from 1,500 head in 1971 to 6,000 head in 1976. The Bureau of Land Management, Rock Springs and Rawlins Districts, are currently seeking ways to reduce the herd to 1,200 head by 1990.

Small Game

Small game animals include cottontail rabbits, snowshoe hares, and red squirrels. Cottontail rabbits occur throughout most of the basin. Low brush and pinyon-juniper are ideal habitat for the desert cottontails. Snowshoe hares were recently reclassified small game animals from their former non-game status. Hares mainly occupy montane coniferous forest, though distribution and density vary considerably by season and year. Red squirrels were also recently reclassified from non-game status to small game animals under Wyoming law. Red squirrels are often seen residents of the montane coniferous forest.

Furbearers

Furbearers include beaver, mink, muskrat, marten, pika, otter, lynx, wolverine, black-footed ferret, and badger. Beaver inhabit the riparian settings. Their total range is limited to waterways and impoundments where adequate food supply, mainly aspen and willow, are nearby. Beaver played an important role in the fur trapping era of the 1820's to the 1840's. Mink and otter inhabit riparian settings also but are seldom seen. Muskrat occupy similar habitat. The otters distribution appears to be increasing. Marten inhabit forested mountain ranges. Within the basin, marten occupy the same lands as the red squirrels and snowshoe hares. Marten are rarely seen by man. Their population is quite high in the basin but rather uncommon in the continental United States. Badger occur through the basin in relatively open areas. The lynx occupies the montane forest land, expecially west of Big Piney in the Wyoming Range. Lynx are nocturnal. Its range and habitat coincides with the snowshoe hare.

The wolverine is the largest member of the weasel family. Its habitat is generally located in remote mountain areas. A few sightings are reported each year. The last sighting was reported in the Pinedale area in 1974.

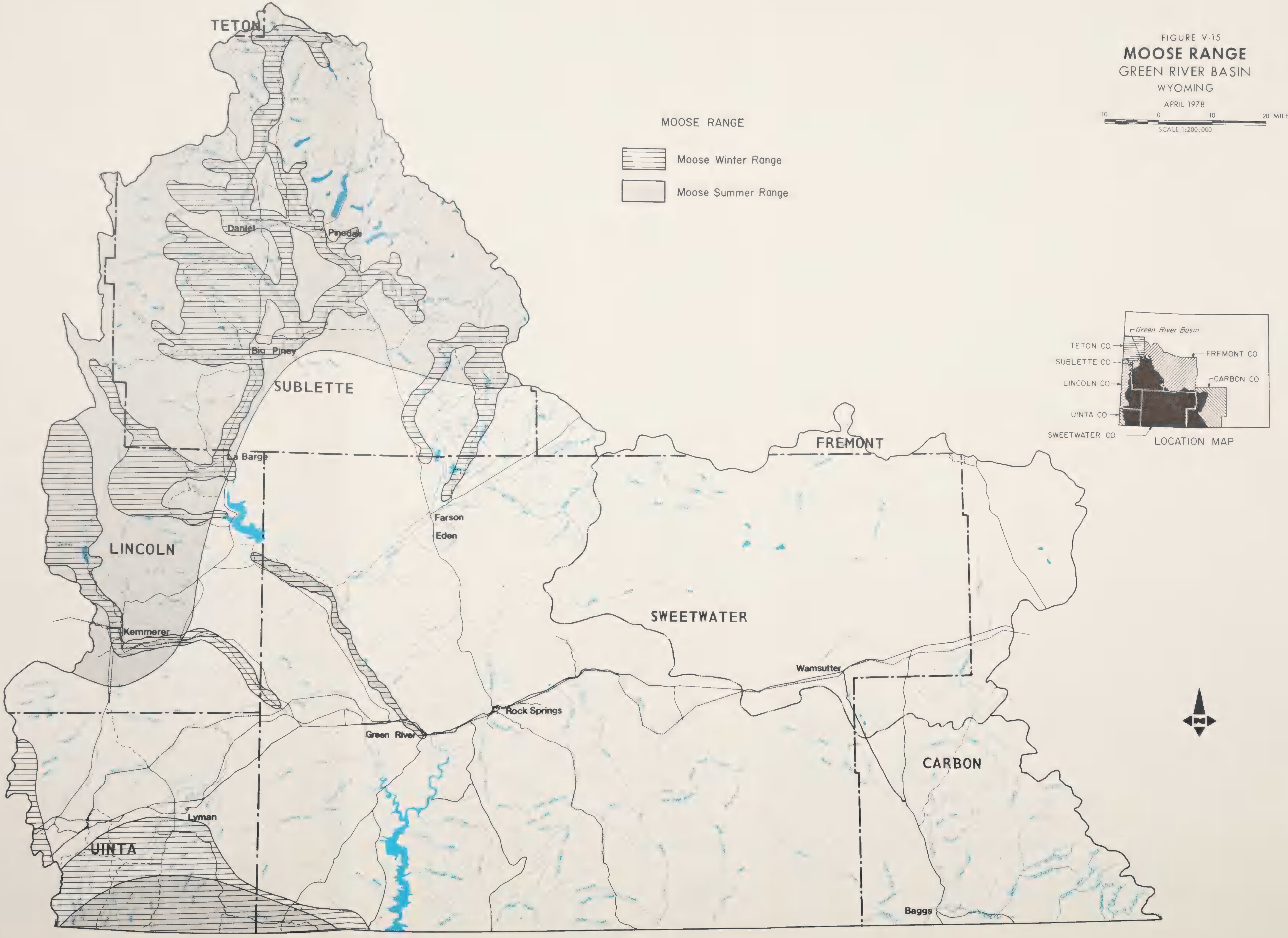
Pika are widely distributed throughout the higher elevations in the Basin. Their habitat is limited to rock slides and talus slopes in alpine areas. Pika "haystacks" of grass and small twigs located among the rocks are evidence of their habitation. Protected furbearers include river otter, lynx, wolverine, and the pika.

The black-footed ferret is one of the rarest mammals in North America. It is officially listed as endangered in the Federal Register. Within the study area, there have been 19 valid ferret sightings and a dozen more that were classed as probably or possible since 1930.

Source:
Prepared by SCS, WTSC Carto Staff from Sublette Investigation MOP Team Cooperative River Basin Survey Map, 1:500,000.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA-SCS-PORTLAND, OR. 1978

Cooperative River Basin Studies
State Engineer, Wyoming Water Planning Program

FIGURE V-15
MOOSE RANGE
GREEN RIVER BASIN
WYOMING
APRIL 1978



Source:
Prepared by SCS, WTSC Carto Staff from Sublette Investigation MOP Team Cooperative River Basin Survey Map, 1:500,000.

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Cooperative River Basin Studies
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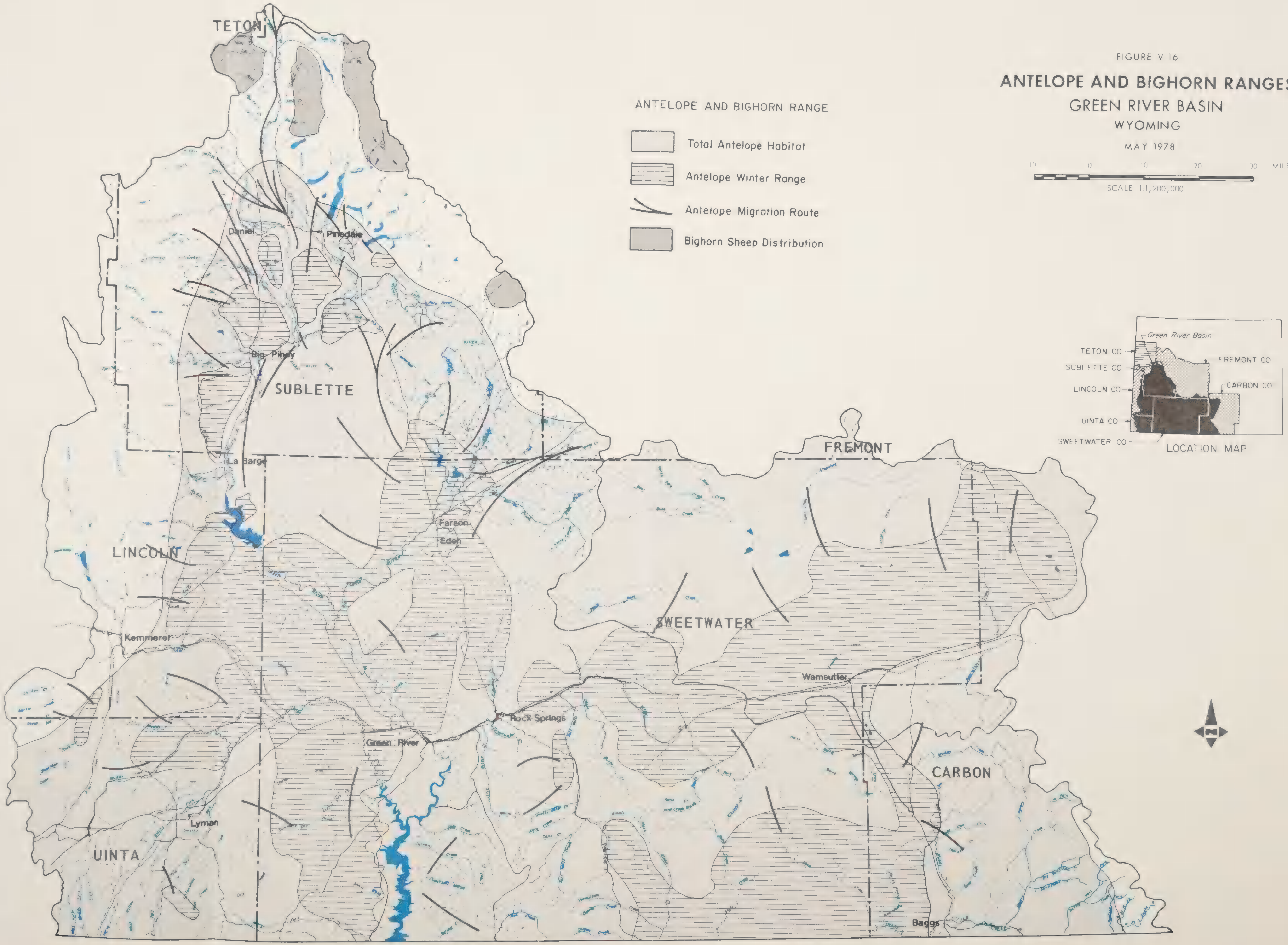
FIGURE V.16

ANTELOPE AND BIGHORN RANGES

GREEN RIVER BASIN

WYOMING

MAY 1978



Source:
Base map prepared by SCS, WTSC Carto Staff from Sublette Investigation MOP Team Cooperative River Basin Survey. Map, 1:500,000.
Thematic detail from Wyoming Game and Fish Commission and U. S. Wildlife Service. 1976.

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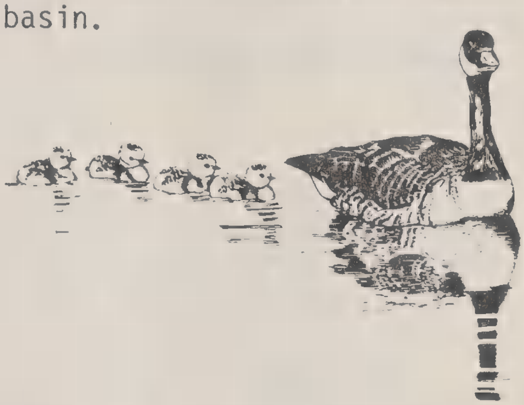
M7-N-22953-21

The relationship between ferrets, prairie dogs, and prairie dog towns has long been known. Prairie dog burrows provide shelter, den sites, and areas to raise offspring, and the inhabitants often provide the meals.

Waterfowl

Migratory waterfowl include geese, ducks, swans, and American coot. Three species of geese migrate through the basin. The white-fronted, snow, and Canada geese frequent the basin's waterways and impoundments. White-fronted and snow geese migrate through the area in the spring and fall. Canada geese are more common and both migrants and residents of the basin. Installation of artificial nesting structures have encouraged reproduction and habitat occupancy by Canada geese.



Ducks are represented by 24 species in two major groups--puddle ducks and diving ducks. Puddle ducks include nine species, the more common of which are mallard, pintail, and various teal. Diving ducks include 15 species, the more common of which are the redhead, canvasback, goldeneye, and merganser. Ducks breed and nest on most waterways and impoundments through the basin (Figure V-17).

Two species of swans inhabit the basin. The whistling swan is the more abundant, while the trumpeter swan is an infrequent spring and fall visitor. Trumpeter swans have occasionally nested in the Upper Green River. Whistling swans nest frequently near the basin wetlands.

American coot are common to waterways and impoundments. They are a gregarious, abundant species, and may be hunted liberally.

An endangered species, the whooping crane has re-entered the Basin. This fact was established by recent sightings of a bird near Pinedale and the finding of a dead whooping crane near Lyman on May 29, 1977. These birds are probably the result of efforts to re-establish whooping cranes near Grey's Lake, in southeastern Idaho.

Migratory Game Birds

Migratory game birds include mourning dove, common snipe, Virginia rail, sora, and sandhill crane. Mourning doves inhabit much of the Green River Basin during the spring and summer, and migrates south from basin lands in late August or early September.

Common snipe, or Wilson's snipe, occurs in association with wetlands, streams, and irrigated lands throughout the basin. Sora and Virginia rail are seldom seen spring-summer-fall residents of wet and irrigated land habitat. They are protected from hunting in the Green River Basin.

Sandhill cranes are quite common nesting residents and migrants. Their population in eastern Idaho and western Wyoming is building to a level where wildlife managers are considering hunting seasons in the future. Two issues are important to future sandhill crane management. First, nesting cranes are quite intolerant to disturbance such as livestock use and agricultural activity; and second, sandhill cranes cause damage to small grain crops.

Band-tailed pigeons are possible residents of the basin though reliable sightings are not known. They are regular residents of Colorado and may make occasional flights into the basin, especially in the Little Snake River Valley.

Upland Game Birds

Eight species of upland game birds are considered worthy of discussion. The species are sage grouse, ruffed grouse, blue grouse, sharp-tailed grouse, white-tailed ptarmigans, ring-necked pheasant, chukar partridge, and gray partridge.

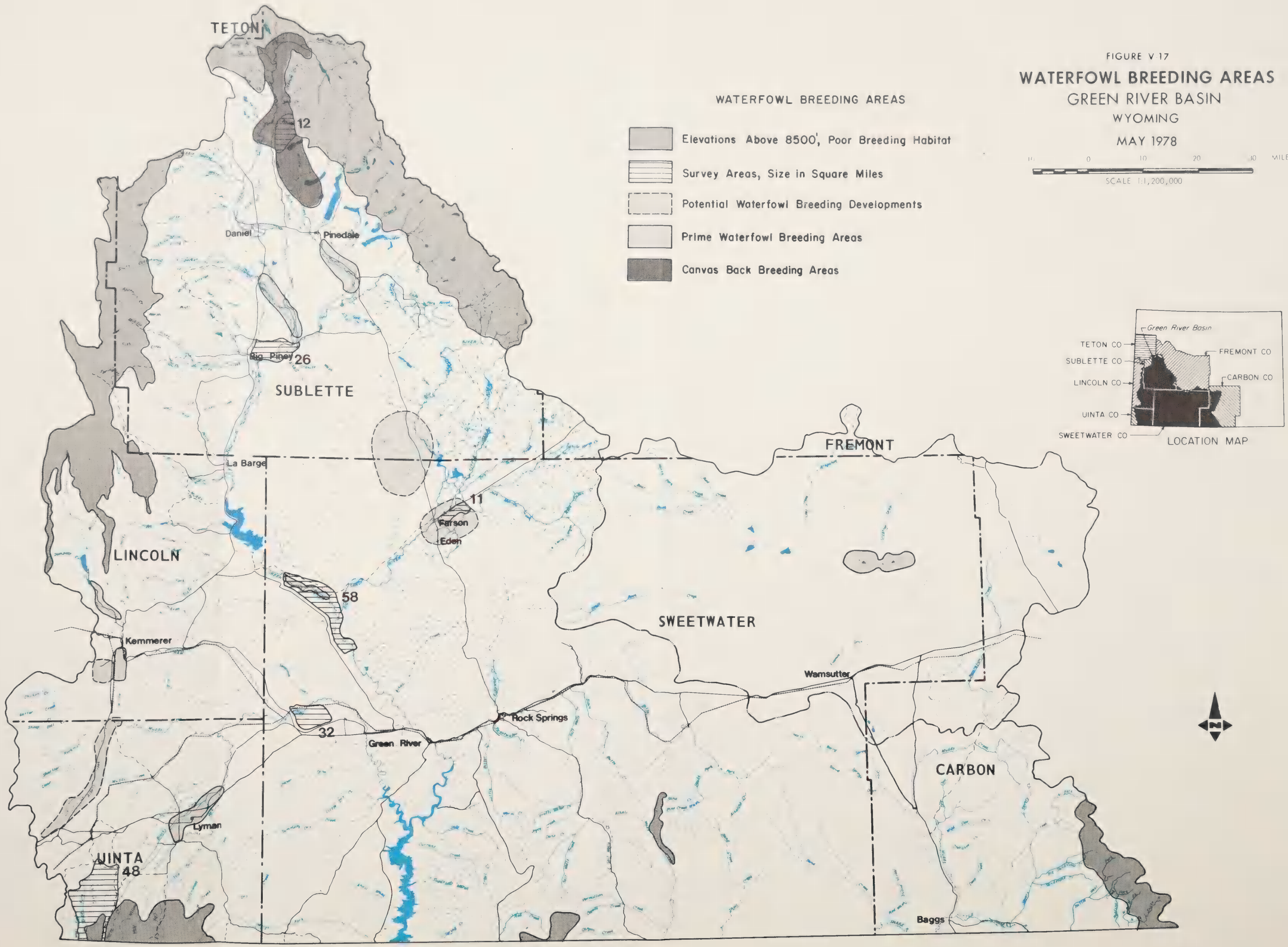
Sage grouse are common and widespread throughout sagebrush and the low shrub high plains desert (Figure V-18). Their winter range is smaller than other seasonal ranges. It is a limiting population factor, although sage grouse winter range is very extensive at present. Another significant limiting factor is "strutting grounds". These are breeding grounds and are located in certain sagebrush vegetative types.

Male sage grouse on strutting ground
Wyoming Game and Fish Commission

FIGURE V 17

WATERFOWL BREEDING AREAS
GREEN RIVER BASIN
WYOMING

MAY 1978



Source:
Base map prepared by SCS, WTSC Carto Staff from Sublette Investigation MOP Team Cooperative River Basin Survey. Map, 1:500,000.
Thematic detail from Wyoming Game and Fish Commission and U. S. Wildlife Service. 1976.

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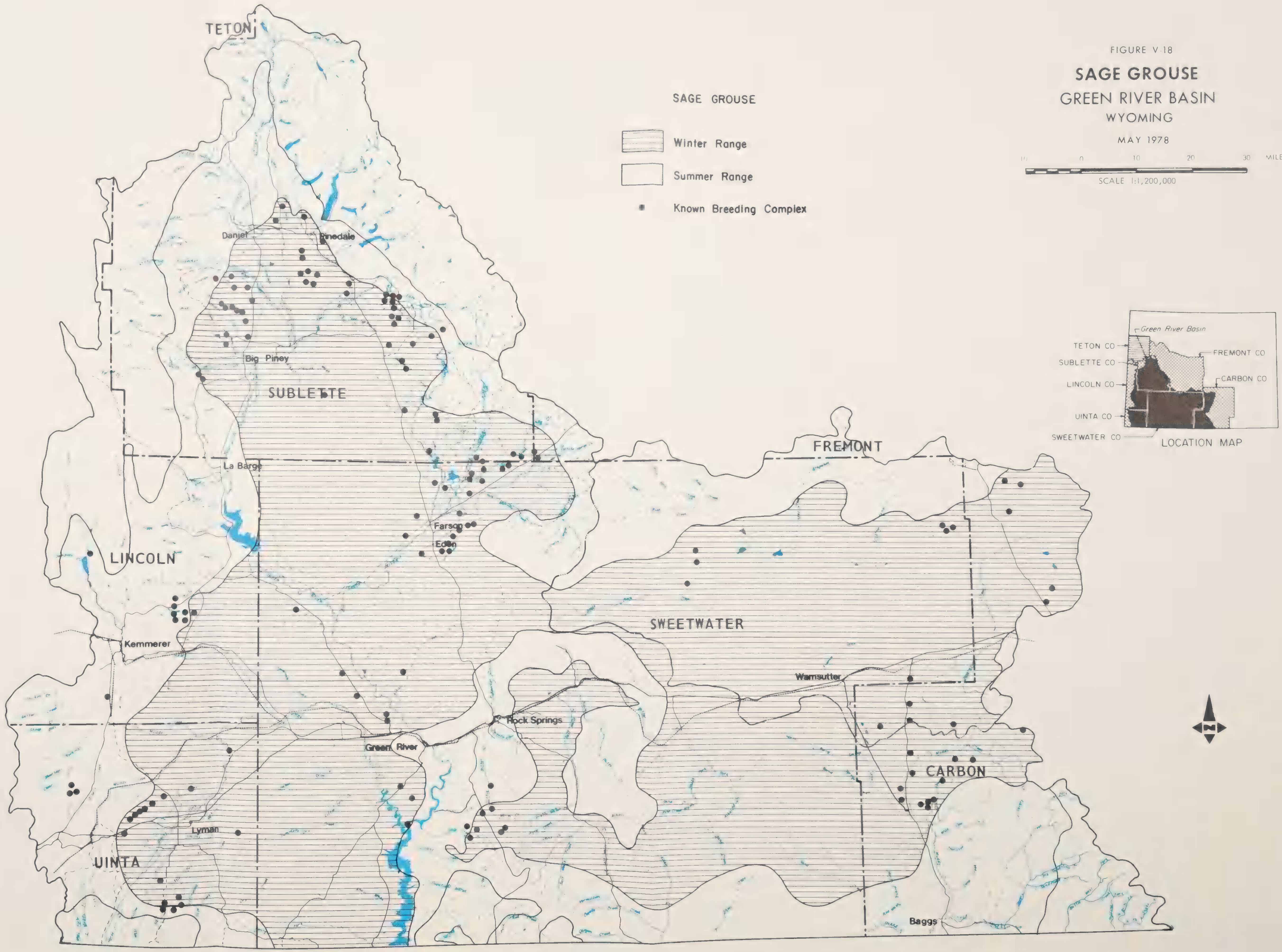
Cooperative River Basin Studies
State Engineer, Wyoming Water Planning Program

M7-N-22953-22

FIGURE V 18

SAGE GROUSE
GREEN RIVER BASIN
WYOMING

MAY 1978



Source:
Base map prepared by SCS, WTSC Carto Staff from Sublette Investigation MOP Team Cooperative River Basin Survey. Map, 1:500,000.
Thematic detail from Wyoming Game and Fish Commission. 1976.

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Ruffed grouse inhabit forested foothills and mountain valleys. Aspen and willow are important habitat. Blue grouse inhabit forested foothills and mountains similar to ruffed grouse. In the winter blue grouse roost in conifer trees, particularly Douglas fir. Blue grouse live at higher elevations in the winter months than ruffed grouse. Columbian sharp-tailed grouse occupy mountain brush and foothill lands only in the Little Snake River drainage. Columbian sharp-tailed grouse are a rare subspecies. They are shown on Wyoming's rare and endangered wildlife list as status unknown.

White-tailed ptarmigan are an alpine and wilderness resident, but no population estimates have been made. Their range is estimated to be the alpine ridges and slopes of the Wind River Range. Ring-necked pheasants are restricted to a small area of agricultural and peripheral lands in Eden Valley. Harsh climatic conditions and modern agricultural practices limit their population and range.

Chukar partridge occupy broken relic and foothill lands where very steep slopes, rocky outcrops, and adequate water occur. Available water is extremely important during the brooding season. However, persistent snow cover of only a few inches can decimate chukar populations during the brooding seasons. Gray or Hungarian partridge occupy some foothill lands and low rolling slopes. Populations are limited.

Non-game Birds

A diversity of non-game bird species are in this group. The Environmental Base Working Paper (4) lists these birds, their abundance, and seasons of use. Non-game birds fill very important functions as insect feeders, scavengers, and food base for other animals.

Birds of prey include eagles, hawks, falcons, vultures, and owls. Basin lands are habitat for two species of eagles, fourteen species of hawks, five species of falcons, ten species of owls, and one species of vulture. All species inhabit states in the inter-mountain region.

The American perigrine falcon is extremely rare in North America and is listed as endangered under the Endangered Species Act of 1973. Reliable reports of perigrine falcon sightings are received from Green River Basin nearly every year. Recovery falcon eyries are being planned nationwide.

The majestic bald eagle is a rare sight in many sections of Wyoming, but observations of this resident near some of the large lakes and rivers in the Green River Basin are not uncommon. The bald eagle is a "permanent resident" and partially migratory and has been recently added to the endangered species list.

Shore birds are exclusive of migratory waterfowl and migratory game birds. Their habitats include open water, marsh, and flooded woodlands. Twelve families and forty-six species are represented. Birds are not listed in this report but are shown in the Environmental Base Working Paper.

Mature bald eagle, a protected species
Soil Conservation Service

Reptiles, Rodents, and Insectivorous Mammals

Reptiles include lizards, snakes, and turtles. Reptiles serve the food chain role of controlling insects and rodents. There are five species of lizards and six species of snakes. No turtles are known to inhabit the area. Amphibians include salamanders, toads, and frogs.

Rodents include marmots, prairie dogs, squirrels, chipmunks, gophers, rats, mice, and voles. Rodents are a very important group from the standpoint of food supply for carnivorous mammals, reptiles, and birds. Subterranean activities of gophers, prairie dogs, and voles are beneficial to the soil and aid in aeration and mixing.

Insectivorous mammals include bats and shrews. Bats include several species and are located throughout the basin in various habitats. Shrews generally inhabit damp, moist areas but also occur under quite arid conditions.

Predators

Non-classified predators include 12 species quite common to the mountain west. These species are not individually described here in the interest of space. Included in this group are coyote, red fox, swift fox, bobcat, racoon, ring-tailed cat, striped skunk, long-tailed weasel, and short-tailed weasel.

Carto A-392

Wildlife Habitat Improvement Potential

The Wyoming Game and Fish Department has identified four areas in the basin as having potential for the development of waterfowl breeding (Figure V-17). These areas are: (1) Farson-Eden area - 5,600 acres; (2) Sublette Flats - 15 miles northwest of Farson - 10,600 acres; (3) Albert Creek area - 4,300 acres; and, (4) Willow Creek area - 1,300 acres (17). Existing breeding areas could also be enhanced by improving nesting conditions along streams, on stock ponds, and reservoirs. Existing significant breeding areas encompass about 27,700 acres.

Critical winter habitat for mule deer, elk, antelope, and moose is at or near carrying capacity. Critical winter habitats are the areas of winter range necessary to carry a herd through a severe or prolonged winter. Improvements of summer range would necessitate corresponding improvements of critical winter habitat to accommodate anticipated increases in animal numbers. Habitat enhancement could be applied to portions of the total critical winter habitats for mule deer, elk, antelope, and moose (Figure V-19). In addition, enhancement and protection of sage grouse breeding areas (over 200 areas identified to date) could be accomplished. A complete description of wildlife species, habitat, problems, and other aspects related to wildlife resource are presented in the Environmental Base Working Paper (4).

Fisheries

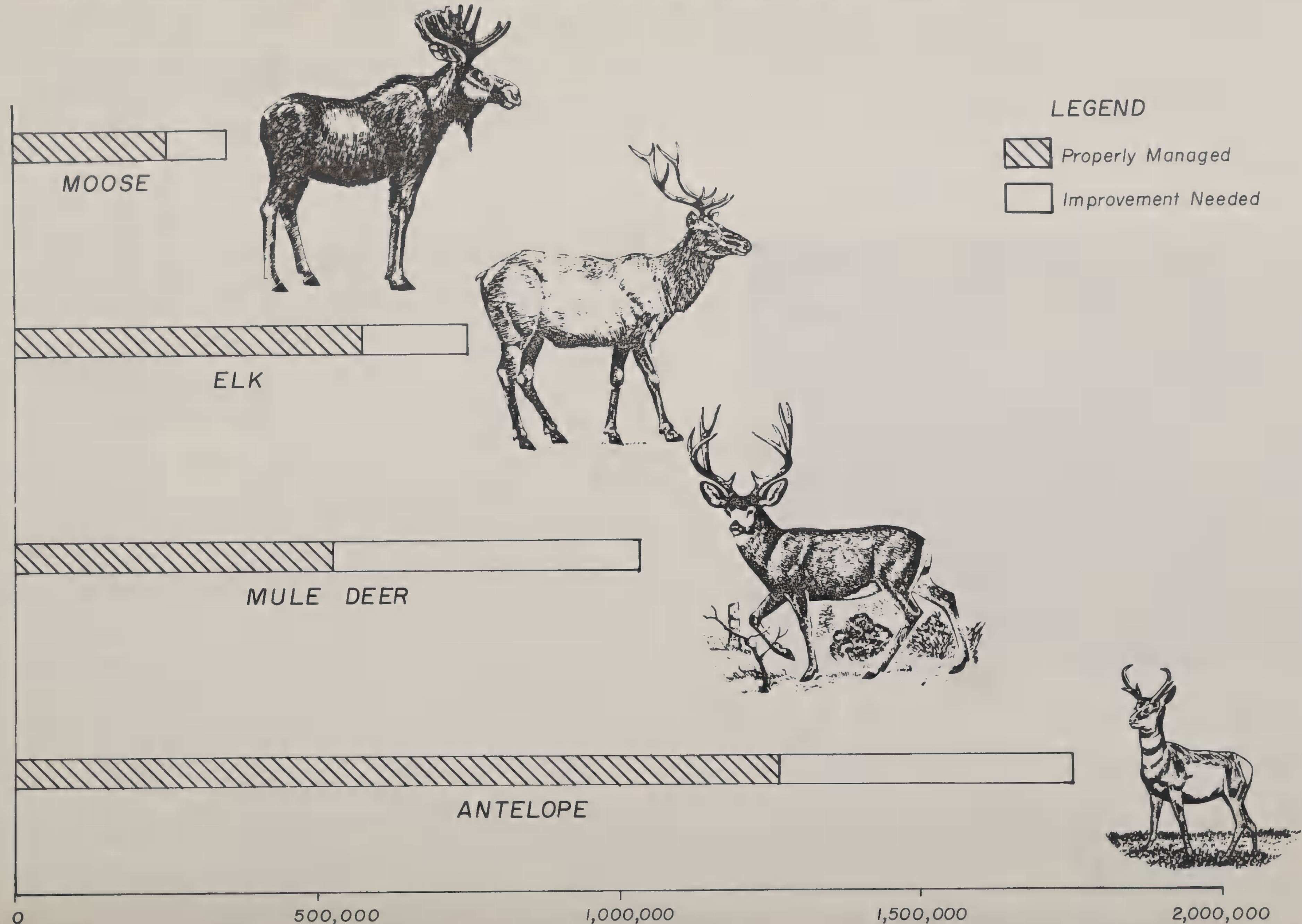
The Green River Basin supports a high quality, cold water trout fishery. Fishing opportunities range from alpine lakes and streams to lowland lakes and rivers. Minimum fishery habitat consists of 2,953 miles of fishable streams and rivers and 32,200 acres of operational fishery habitat in ponds, lakes and reservoirs (25).

Predominant game fish species include 10 species of salmonoids, grayling, whitefish, smallmouth bass, and catfish. The salmonoids species are kokanee salmon and six species of trout--cutthroat, rainbow, brown, brook, lake, and California golden. Nongame fish include carp, suckers, dace, chubs, and sculpins.

In the game fish subgroups, cutthroat trout is very important. Four Green River Basin streams support a rare subspecies of cutthroat trout. This subspecies, Colorado River cutthroat trout, occurs in Beaver Dam, Hollow Creek, Horse and Archie Creeks. Also, the headwaters of the Little Snake River drainage in Carbon County support populations which best represent this subspecies. Recent studies indicate more extensive distribution in the Wyoming Range streams and the upper Blacks Fork drainage.

Many fine brown trout fisheries are located within the Green River Basin. Better fisheries include the Green River, Big Sandy Reservoir, Soda Lake, Big Sandy River, and Flaming Gorge Reservoir. Brook trout are abundant in the upper basin lakes and streams.

Figure V-19 Critical winter habitats, Green River Basin, Wyoming



Mixed catch of trout
Wyoming Game and Fish Commission

Lake trout or mackinaw were introduced in 1939 and have become a prized trophy fish in Wyoming. Most notable of several lakes with self-sustaining mackinaw populations is Fremont Lake in Sublette County. Golden trout were stocked widely during the early 1900's in a number of high mountain lakes in Wyoming. Several lakes of the Jim Bridger Wilderness Area are particularly known for their golden trout populations. Kokanee salmon constitute significant populations in Fremont Lake and Flaming Gorge Reservoir. Grayling, a native game fish, is an important novelty species. Meadow Lake near Pinedale supports a thriving grayling fishery. Flaming Gorge Reservoir is a noted German brown trout fishery. Limited numbers of smallmouth bass occur in Flaming Gorge Reservoir. Similarly, catfish are limited in number and are known only in the Little Snake River.

Kendall Warm Springs dace are the single classified endangered fish species in the basin. The dace are a rare subspecies within a very limited warm water habitat. These dace are unique to Kendall Warm Springs and are located near the site of the old Kendall Warm Springs Ranger Station in the Bridger National Forest.

Fisheries habitat in the Green River Basin is best characterized by the Wyoming Game and Fish Commissions's river, stream and lake inventory. The Commissions's inventory and update work since 1961 has produced a very creditable fishery data base. The most recent update, March 1977, was available for this writing (25).

An overall classification of each fishing stream is assigned. The classification is based upon a combination of three criteria: fish productivity, stream esthetics, and stream availability.6/ Figure V-20 gives the miles of stream by quality. Esthetics and availability are defined and described later in this chapter. See Figure V-21 for location of stream and streamflow quantities.

Several miles of stream have been identified as having seasonally low flows which limit the fisheries' productivity. They are: Fontenelle Creek - 25 miles; Middle Piney Creek - 9 miles; LaBarge Creek - 30 miles; South Horse Creek - 6.5 miles; Tosi Creek - 14 miles; Hams Fork - 34 miles; and Green River below Fontenelle Dam - 69.5 miles. Total miles of streams where significant improvements in streamflows could be made are 188.

Recreation Facilities and Resources

Recreation attributes include both man-made facilities and natural resources that are utilized in leisure time activities. Some are consumptively used like game and fish. Others range from the scenery that enhances recreation experiences, to the tree that holds up a tent or fuels a campfire. The Recreation Working Paper provides further detail of recreational resources (7) and Appendix I of this report gives summaries of facilities available. The major recreation activities and facilities are discussed in the following paragraphs.

Trails are an important recreation facility that help make horseback riding and hiking enjoyable. With a pack horse or a pack on their backs, travelers can wander unhurriedly through spectacular scenery. National Forest trail facilities total 1,069 miles.

6/ The three criteria are weighted by multiplying esthetics by one, availability by two, and productivity by four. Using the sum of the weighted values, the appropriate fishery class is defined by the following ranges - class one (31-35); class two (25-30); class three (18-24); class four (11-17); and class five (7-10). See Appendix II for complete definition.

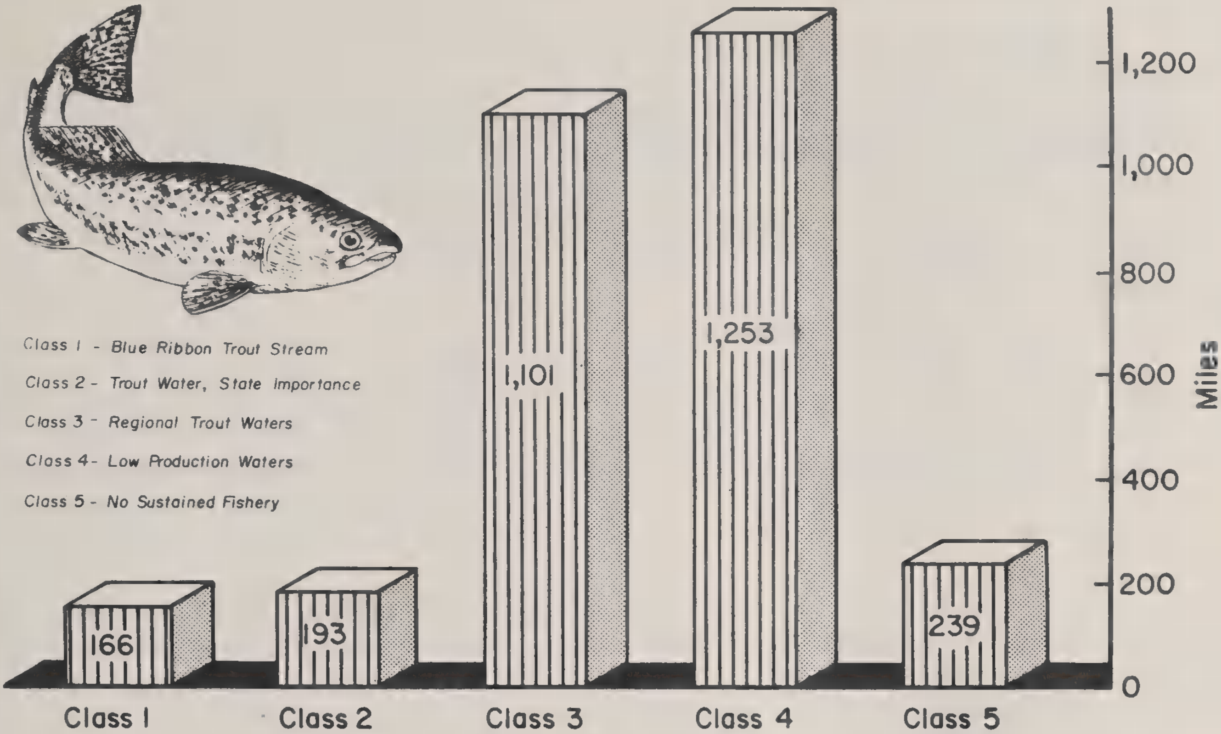


Figure V-20 **Fishing stream quality, Green River Basin, Wyoming**

Class 1 - Blue ribbon - premium trout waters. Of 166.0 miles of blue ribbon stream and river, 73 miles support high fish populations of better cold water game fish, and the fishing water is large enough to support heavy to moderate fishing pressure. The other 93.0 miles support a moderate game fish population. Fishing waters are moderate in size and can support much fishing pressure.

Class 2 - Red ribbon - very good trout waters. Of 193.1 miles of very good trout waters, 184.1 miles support moderate game fish populations and are moderate in size. They can withstand much fishing pressure. Nine miles are generally small but productivity is good and can withstand heavy to moderate fishing pressure. In some cases waters are large, and productivity is low enough so hatchery stocking is required to maintain success.

Class 3 - Important trout waters. Of 1101.9 miles of important trout waters, 45.0 miles support moderate game fish populations and are moderate in size. Productivity is high, and these waters can withstand much fishing pressure. Of the remaining, 706.0 miles are generally small with good productivity and can support heavy to moderate fishing pressure, and 350.9 miles are small and/or cannot withstand much fishing pressure.

Class 4 - Low production waters, local importance. Of 1253.2 miles of low production waters, 63.0 miles are generally small with high productvity and can withstand heavy to moderate fishing pressure. Of the remaining, 657.7 miles are generally small and cannot withstand much fishing pressure; and 532.5 miles support low populations of game fish, if any, and cannot support successful long term fisheries.

Class 5 - Very low production waters. Of 239.3 miles of very low production waters, all mileage supports low populations of game fish, if any, and cannot support successful long term fisheries.

Campgrounds provide water and sanitation facilities for overnight recreation users. People provide their own shelter and sleeping accommodations using trailers, pickup campers, or tents in public campgrounds or commercial facilities. There are 10 commercial facilities in the basin. Facilities administered by public agencies are usually at a terminal destination where recreation opportunities or spectacular scenery attracts people. There are a total of 36 campgrounds in the basin on 389 acres.

Picnic sites usually consist of a group of tables, parking areas, sanitation, water, and shade. There is less dispersion among the units than in campgrounds, and facilities are more geared to short term use. Many campgrounds are used for picnicking and to a lesser degree some picnic sites are used for camping. There are a total of 26 picnic sites in the basin on 386 acres.

Boating facilities are located on the largest reservoirs and lakes: Viva Naughton Reservoir, Fremont Lake, New Fork Lake, and Flaming Gorge Reservoir. Some boating facilities are primitive, consisting of an unpaved launch ramp and perhaps a floating dock. Other facilities, like Buckboard Crossing on the Flaming Gorge Reservoir, consist of a concrete launch ramp, store, marina, trailer dump station, fish cleaning station, parking and satellite campground, picnicground, and administrative facilities. Most boating, with the exception of Flaming Gorge Reservoir, is in conjunction with fishing. Cold air and cold water temperatures limit water skiing and water contact sports throughout the basin. Eleven boat launching sites are located in the basin.

Parks and playgrounds are part of the recreation facilities at the larger communities. Not only do these areas provide recreation opportunities, but they also enhance the environment by providing open and green space, dispersing traffic, and providing esthetic enjoyment to community residents. There are 279 acres committed to city and county parks and playgrounds.

Private guest ranches, resorts and lodge facilities provide recreation opportunities especially in Sublette County and near the Medicine Bow National Forest in Carbon County. There may be over guest ranches in the Green River Basin than the 29 indicated by the Recreation Inventory conducted by the Wyoming Association of Conservation Districts. During the hunting season, and in the summer, nearly every ranch family is visited by relatives who enjoy participating in ranch life and activities.

Some recreation facilities are provided by private programs, such as the National Outdoor Leadership School and youth camps on the fringe of the wilderness area. These camps and programs provide recreation opportunities for youth from all over the United States and other countries. There are also five camps run by the Boy Scouts and church organizations. They occupy 69 acres and are all located in Sublette County.

Summer homes or recreation residences are built by those who can afford the luxury of this large capital investment and who have the leisure time to use them. This is one of the most rapidly growing

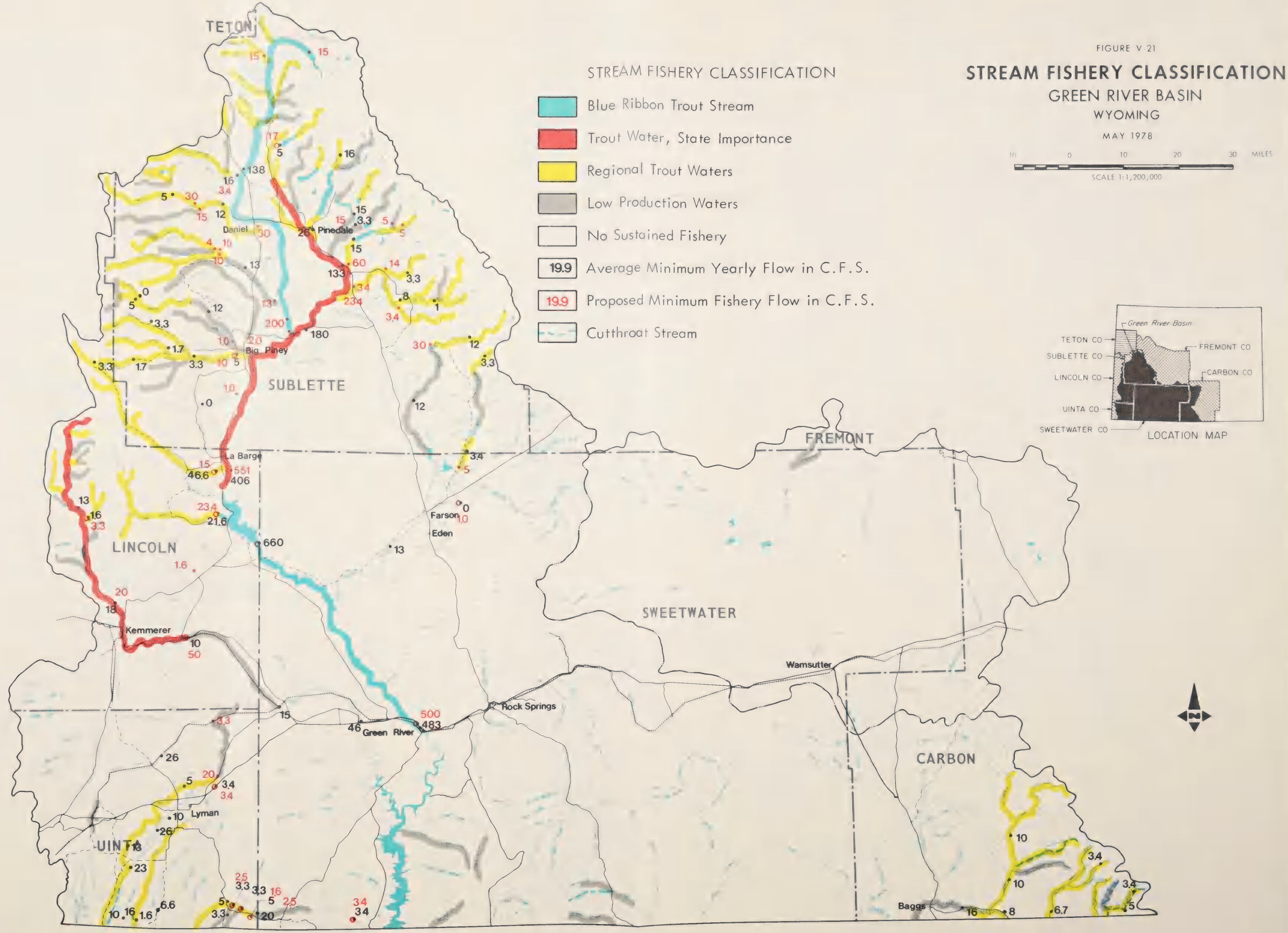


FIGURE V-21

STREAM FISHERY CLASSIFICATION
GREEN RIVER BASIN
WYOMING
MAY 1978

Source:
Base map prepared by SCS, Portland Carto. Unit from USGS 1:1,000,000 National Atlas.
Thematic detail by Wyoming Game & Fish Commission, Revised 1976 & USGS Stream Gauge Records, 1932-Present.

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State Engineer, Wyoming Water Planning Program

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recreation uses of the land base in the Green River Basin. Few summer home areas are adequately planned to protect scenic and environmental qualities. Esthetic and sanitation problems are common, and police and fire protection is usually nonexistent.

Most new residences being built in Sublette County are oriented to recreation. In 1970, it was estimated there were about 300 recreation residences in the county, and 2,000 acres subdivided for recreation residences. By 1975 there were 2,015 recreation lots sold or for sale and 12,105 acres subdivided or proposed for subdivision for recreation residences. There are also 86 summer homes occupying about 130 acres on National Forest lands in Sublette County. Because of difficulties in defining a "recreation residence," information for other counties was not compiled.

Rest areas, scenic overlooks, and historic sites compliment other recreation facilities. Rest areas vary from elaborate facilities on Interstate Highway 80 that have picnic tables, shelters, water and sanitation to frequently used turnouts without facilities on other roads.

Historic sites also vary from the elaborate interpretative museum at historic Fort Bridger to an occasional sign. Many historic sites are not identified for the traveler nor protected from destruction. There are 127 historic sites, buildings and structures inventoried in the study area. Records show 26 sites and buildings in Lincoln County: 21 in Sublette County; 49 in Sweetwater County; 1 in Fremont County; 26 in Uinta County; and 4 in Carbon County.

The capacity of resources and developments were evaluated for principal recreation activities. Table V-8 presents the annual participation and fishing capacity of recreation sites, rivers and streams.

Scenic Stream Corridors, Lakes, and Other Landscapes

Streams and Rivers

Stream and river corridors on the basin floor are zones of human and livestock occupancy. Also, stream corridors are zones of scenic contrast because nearby semi-arid, sparsely vegetated lands often are desolate and lack visual appeal.In the mountains and forests, the streams and rivers are but one element of pleasing natural landscapes. People use mountain streams seasonally and occasionally rather than yearlong. Concentrated human and livestock uses have depleted vegetation in some areas.

The Wyoming Game and Fish Division has measured stream and river miles for the basin (25). Total drainage miles are 6,240 miles and include most intermittent and permanent waters. Of the 6,240 miles, 3,568 have been classified for esthetic conditions and for availability to the public (primarily fishermen). Table V-9 gives the miles by esthetics classes for the counties in the basin.

Boating facilities on Fremont Lake near Pinedale
Soil Conservation Service

Sunbathing and swimming in Fremont Lake
Soil Conservation Service

Table V-8 Annual participation capacity of recreation sites and fishing capacity of streams and lakes, 1975, Green River Basin, Wyoming

Activity	Unit	Amount	Participation capacity (days) 1/
Boating	Launching sites	11	144,090
Camping	Sites	36	372,000
Trail heads	Number	6	XXX
Picnicking	Sites	26	162,620
Fishing			Fishing capacity (days) 2/
Streams	Miles	2,953	325,075
Lakes	Acres	69,700	474,750

1/ Participation capacity is the participation that can be accommodated without deterioration of the recreation site with allowances for peak days.

2/ Number of fisherman days a stream segment or flat water area can accomodate without deterioration of the resource or recreational experience.

Thirty percent of the stream miles or 1,085.6 miles (Esthetic Classes 4 and 5) have outstanding natural beauty. In contrast, 22 percent or 779.5 miles (Esthetics Class I) have been degraded by man's activities or natural occurrences.

Streams and rivers have been classified as to their availability for public use and viewing. Sixty-seven percent or 2,390.9 miles (Availability Classes 3 through 5) are reasonably available. Conversely, 33 percent or 1,117.6 miles (Availability Classes 1 and 2) are less available or not available to the public. Table V-10 presents the miles available by availability class, miles, and county.

Lakes

Lakes, reservoirs, and other flat waters are significant in size and number along the mainstem of the Green River and in the Jim Bridger Wilderness area. In size, Flaming Gorge and Fontenelle Reservoirs are the largest. In Wyoming, Flaming Gorge has a surface area of 28,620 acres. Fontenelle Reservoir has a surface area of 8,100 acres. More than 1,300 lakes dot the rugged granite landscape of the Jim Bridger Wilderness area. Many of these wilderness lakes are very small. Those of less than one acre were not inventoried. Table V-11 presents the number of lakes by county and surface acres.

Table V-9 Stream and river esthetics, Green River Basin, Wyoming

	County					
	Miles					
Esthetics 1/	Lincoln	Sublette	Sweetwater	Uinta	Carbon	Basin total
5 - Outstanding natural beauty (unique or wilderness)	3.5	504.7	0.0	0.0	0.0	508.2
4 - Outstanding natural beauty (human developments present)	59.4	448.5	69.5	0.0	0.0	577.4
3 - Considerable natural beauty (more common stream types)	142.2	454.2	22.3	151.4	157.0	927.1
2 - Average esthetics (often bordered by abused lands)	161.7	257.5	80.5	165.2	111.0	775.9
1 - Fair esthetics (often turbid and lacking streamside cover)	154.5	213.5	183.7	114.1	114.1	779.9
TOTAL	521.3	1,878.4	356.0	430.7	382.1	3,568.5

1/ Definitions of esthetics classes and source: Wyoming Game and Fish Commission, Rivers, Streams, Lakes Inventory, March 1977 Revision.

Class 5 Streams of outstanding natural beauty usually clean and clear.

Class 4 Streams comparable to 5 but lacking wilderness characteristics. Presence of human developments such as roads, farms, or commercial establishments.

Class 3 Streams of considerable natural beauty but of a more common type than listed under 5 and 4. Clean and usually clear streams flowing through attractive agricultural areas or rough lands with picturesque scenery.

Class 2 An area with average scenic qualities. Stream types are fairly common, usually with clean waters and bordered by abused lands.

Class 1 A stream of fair esthetic stream qualities. Water is often turbid. Surrounding country has only mediocre scenic appeal and is of common occurrence. A lack of streamside cover is apparent. Mudbanks are common and streamflows occasionally may become so low as to expose extensive mud flats and sandbars. Noxious domestic and industrial wastes may occur. Streams primary esthetic appeal usually lies in the fact that it offers local people an opportunity to get outdoors near some water.

Table V-10 Stream and river availability, Green River Basin, Wyoming

Availability class 1/	Miles					
	Lincoln	Sublette	Sweetwater	Uinta	Carbon	Basin total
5 - Accessible by automobile and floatable (Stream access good, little posting)	11.2	148.8	69.5	0.0	0.0	229.5
4 - Vehicle access relatively good (Streams not floatable)	122.9	105.5	150.5	125.8	0.0	504.7
3 - Road or trail for jeep, horse or afoot (Posting not restrictive)	246.1	967.3	40.0	125.4	180.9	1,559.7
2 - Accessibility difficult or posting extensive	134.4	583.3	96.0	171.2	97.0	1,081.9
1 - Accessibility inadequate (natural or institutional restrictions make use almost impossible)	6.7	73.5	0.0	8.3	104.2	192.7
TOTAL	521.3	1,878.4	356.0	430.7	382.1	3,568.5

1/ Definition and source: Wyoming Game and Fish Commission, Rivers, Streams, and Lakes Inventory, March 1977 Revision.

Class 5 Accessibility to fishing waters by road is satisfactory for modern cars (not excessive such as highway bordering the stream). Stream access in terms of posting and availability to fisherman use very good. Camping and lodging opportunities available, stream floatable.

Class 4 Vehicular access, relatively good (may be excessive as described in 5), posting not extensive, streambank cover not restrictive to fisherman. Stream not floatable.

Class 3 Accessible by road or trail. Is fit for jeep, horseback or foot travel. Posting not considered as an important restrictive problem.

Class 2 Accessibility is often so difficult or posting so extensive as to seriously restrict fisherman access.

Class 1 Accessibility is inadequate as natural or man-made restrictions cause fisherman utilization to be almost impossible.

Southern area of Flaming Gorge Reservoir
Soil Conservation Service

Flat water esthetics range from nearly pristine to unique in the Wind River and Wyoming Mountain Ranges. In the low lands, esthetics are usually pleasing, though a few ponds are degraded from heavy livestock, wild horse, game animal, agricultural, or commercial uses. Most lowland settings have sufficient riparian vegetation and desirable shoreline esthetics.

Table V-11 Flat water - number and area by county, Green River Basin, Wyoming

County	Alpine lakes and res.		Lowland lakes and res.	
	Number	Surface acres	Number	Surface acres
Lincoln	22	620	5	9,680
Sublette	605	28,110	9	2,690
Sweetwater	0	0	47	39,900 1/
Teton	1	100	0	0
Uinta	5	550	33	1,450
Carbon	1	20	9	230
Total	634	29,400	103	53,950

1/ Includes intermittent lakes in Great Divide Basin.

Other Landscapes

In the few concentrated agricultural settings, a pleasing pastoral visual quality occurs. Bridger Valley, Little Snake River Valley, Pinedale, and Big Piney agricultural settings exemplify pleasing pastoral settings.

Some urban and few rural settings display haphazard developments. Where haphazard developments occur, unattractiveness and incongruousness prevail. Rapid expansion in the Rock Springs, Green River areas and along portions of Interstate 80 are examples of this condition.

The Sublette Investigation Team from the Bureau of Reclamation classified visual attractiveness for all basin lands (22). Attractiveness was judged simply by variety of vegetative and land form types. The more varied the vegetation and land form, the more visually attractive the landscape was judged to be. Figure V-22, displays four classes of visual attractiveness. The reader should note that two classes, average and high, are associated mainly with mountain and water settings. Areas of each visual attractiveness class are shown in Table V-12.

Many specific landscapes in Wyoming's Green River Basin have outstanding beauty and natural interest. Nine such landscapes or features exhibit distinguishing characteristics. They are:

1. Wyoming Mountain Range
2. Wind River Mountain Range and Jim Bridger Wilderness Area
3. Adobie Town and Red Creek Areas
4. Big, Little, and Middle Firehole (Flaming Gorge National Recreation Area)
5. Boars Tusk
6. Sand Dune Area
7. Chain Lakes
8. Blue Forest
9. Sierra Madre

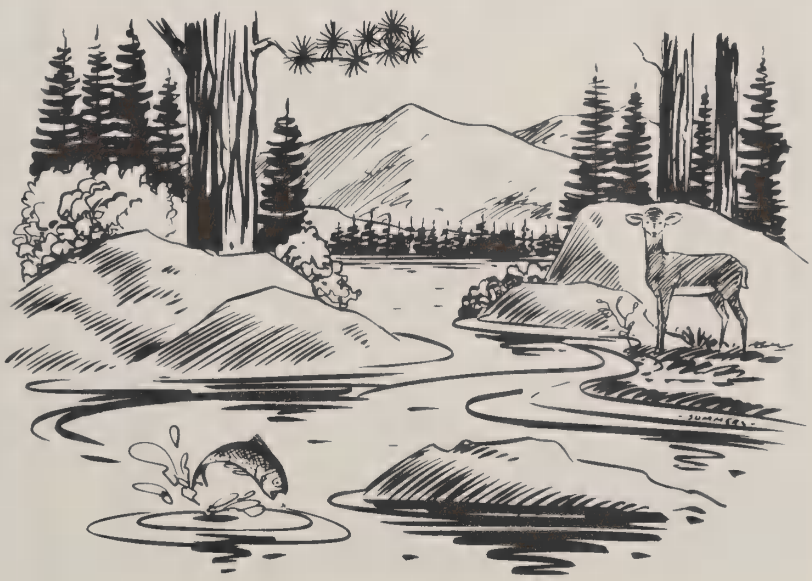


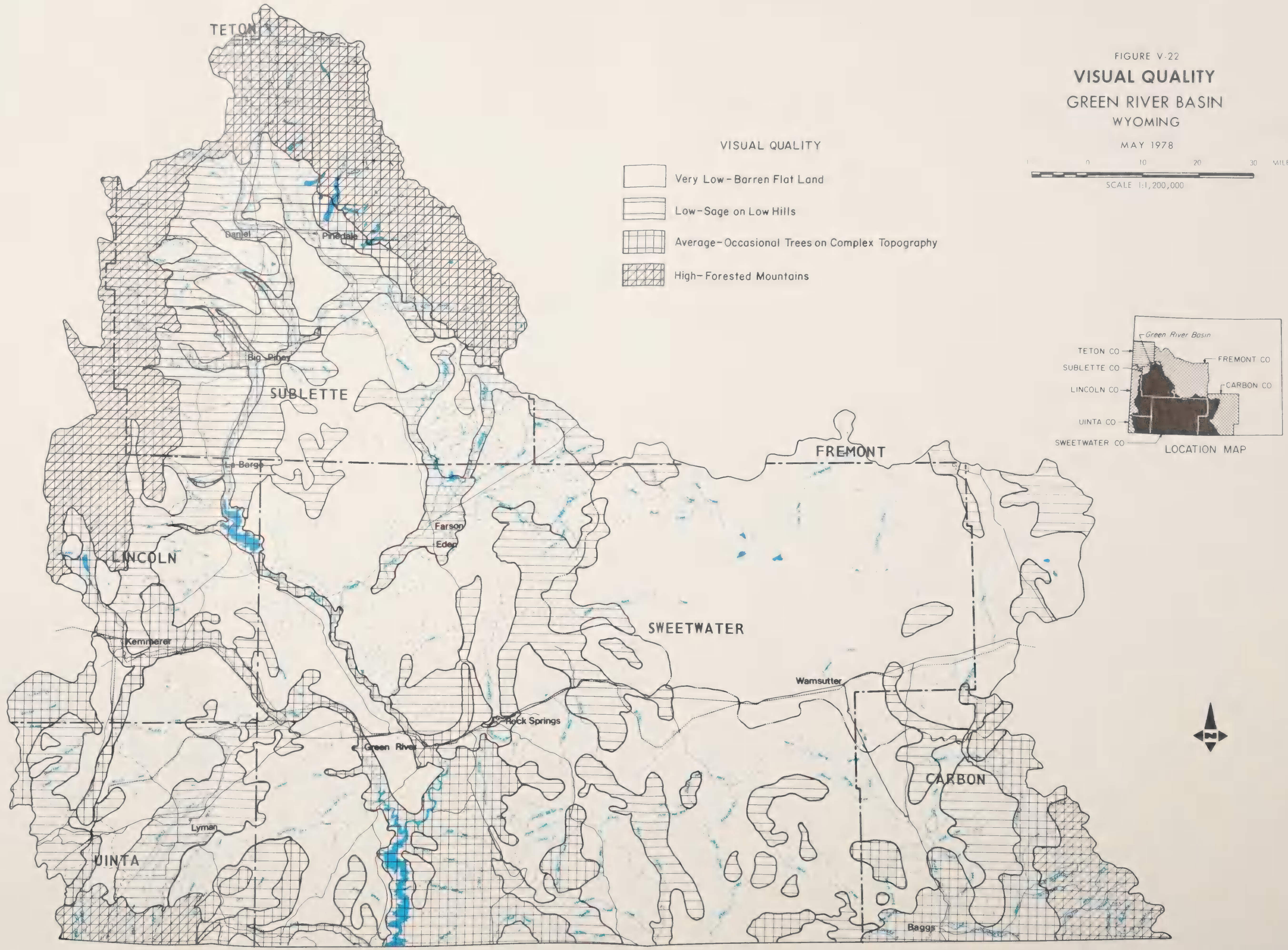
Table V-12 Visual quality - acres and percent by county, Green River Basin, Wyoming

County	Total area	Visual classes and types: High; forested mountains	Average; occasional trees on uplands	Low; sage on low hills	Very low; barren flatlands
Lincoln	1,231,900	308,000 (25)	295,700 (24)	209,400 (17)	418,800 (34)
Sublette	2,824,800	1,073,400 (38)	254,200 (9)	847,400 (30)	649,700 (23)
Sweetwater	6,642,200	0 (0)	531,400 (8)	1,262,000 (19)	4,848,800 (73)
Uinta	1,027,500	133,600 (13)	133,600 (13)	421,200 (41)	339,100 (33)
Carbon	1,449,800	210,000 (14)	360,000 (24)	344,900 (23)	584,900 (39)
Total 1/		1,725,000 (13)	1,574,900 (12)	3,085,000 (23)	6,841,300 (51)

1/ The 154,700 acres in Fremont and Teton Counties not classified.

FIGURE V-22
VISUAL QUALITY
GREEN RIVER BASIN
WYOMING

MAY 1978



Source:
Base map prepared by SCS, WTSC Carto Staff from Sublette Investigation MOP Team Cooperative River Basin Survey. Map, 1:500,000.
Thematic detail from Bureau of Reclamation Study using Jacobs-way Visual Evaluation Method. 1976.

Cooperative River Basin Studies
State Engineer, Wyoming Water Planning Program

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

M7-N-22953-20

Culture Resources

Archeology

Archeological discovery and data compilation are in their infancy in southwestern Wyoming. Investigations to date, however, reveal that human occupancy dates from 13,000 years ago. More widespread occupancy dates from 2500 years B.C. The 800 recorded archeological sites discovered thus far are considered a rather small number. Archeological site location is influenced by topography, site type, and related socio-economic variables (18).

In the mountain environments of the Uinta, Salt River, Wyoming, Wind River Ranges, and the Sierra Madre, little archeological information is verified. All occupations represent summertime activities of mostly big game procurement and quarrying for soapstone or occasionally chert. Food plant collecting is suspected, but little evidence has been found.

Deer, mountain sheep, and buffalo were procured at mountain kill sites for food. Remains of blinds, stone drive lines, and brush fences used in high mountain passes as funnelling mechanisms have been discovered.

At least three soapstone localities are known in the Wind River Range. Soapstone bowls and platters, as well as straight and elbow pipes found on recorded sites were probably quarried within the basin. Quantities of artifacts found are small and mostly relate to cultures younger than 1,000 years ago.

The majority of mountain sites recorded are lithic scatters, often in or near passes. From artifacts discovered, it appears possible to determine the direction from which prehistoric people came. This is discernable from distinct chert types in the various basins of Wyoming. In the basin floor environs, more studies have been made because of long seasonal accessibility and industry related surveys. The valley floors of the Green River, Great Divide, and Washakie basins have a significant number of recorded sites.

Major site patterns on the basin floor are related to land features such as sand dunes, playa lakes, springs, streams, breaks in topography, and prehistoric vegetation patterns. Other sites follow no topographic or vegetative pattern.

Dune areas probably include many unrecorded sites, though little systematized archeological work has been done on overall site types and patterns. Information recorded in dune areas consist of lithic scatters from various prehistoric periods. Such artifacts as fire cracked rock, grinding stones, and slabs have been discovered. Many dune sites represent winter camps located there because of suitable shelter materials and protection from the wind. An area southeast of Eden, Wyoming, is probably the location of a parabolic dune bison trap and butchering site. This is the only documented animal sand trap in the basin, though others are suspected.

Archeological remains found along streams and near springs are as common as those discovered in sand dune areas. However, little archeological investigation near springs has been carried out. Only Pine Springs near Flaming Gorge has been studied in depth. The more common material present is lithic scatters and fire cracked rock. A number of stone circles have been recorded near or along streams in the basin. Associated with the stone circles are occasional hearths. Petroglyphs also have been discovered on the rock walls adjacent to streams. In the Flaming Gorge area, petroglyphs are more common than elsewhere.

Buffalo kill sites have been located near streams. One such site, known as the Wardell Buffalo Trap, has been found along the Green River. A similar site is recorded on Fontenelle Creek. An 800-foot line of stone piles near the Green River is suspected of being a drive line for a buffalo jump and kill area.

Playa lakes are important archeologically. The archeological analysis for one playa lake area is nearly complete. Spot checks have been made on several more. If patterns from initial analysis hold true for other playa lakes, most occupations will date from 0 A.D. to historic contact with the heaviest occupations between 0 A.D. and 900 A.D. Significant site types include kill sites, stone structure, petroglyphs and pictographs, quarry sites, and ceramic sites.

Historic Trails and Sites

The Green River Basin is rich in history pertaining to white man's use and occupancy since the early 1800's. The fur traders were the first white men to enter the basin. Next came the explorers, followed by the missionaries and the wagon road, and railroad builders. Along with the road builders or shortly afterward came nomadic sheepmen and the cattlemen. Settlers came last and are responsible for initiating the first efforts at crop production (1).

A myriad of historic trails and wagon roads are interwoven across the basin lands. The principal emigration trail, to the rich forested lands of Oregon and the gold fields of California, entered the basin on the east side at South Pass and became known as the Oregon Trail. It has been estimated over 500,000 emigrants passed through South Pass in the late 1840's and early 1850's. From near South Pass, the emigrant trail had numerous branches stretching across the basin, depending on whether the travelers were going to Salt Lake City, Oregon, California, Nevada, or Idaho. Many miles of these trails are still visible today, and a few are plainly marked. Along these trails, numerous historical events occurred. Some are identified and well marked; many are not. About 1,318 miles of historical trails have been identified with the most famous

ones being the Oregon Trail, Overland Trail, Lander Road, Pony Express Trail, and Sublette Cutoff (Oregon Cutoff Trail). Table V-13 and Figure V-23 display historical trails by counties. Figure V-23, Historic Sites and Trails map does not show all known sites or trails.

Remnants of the Overland Trail north of Baggs

South Pass, Fort Bridger, and Names Hill are the more prominent historical sites. Altogether there have been 84 historical sites identified. Of this amount, 14 have been registered. Table V-14 gives an inventory of the historical sites by counties.

Paleontology

The Green River Basin is rich in fossil resources which have accumulated over long periods of sediment deposition from geologic processes. Mountain building and the retreat of shallow seas created thick marine and stream sediments. Sediments entombed numerous plants and animals (11).

Even though the first fossil vertebrates were described in the middle nineteenth century, the Green River Basin is far from being intensively explored paleontologically. Undiscovered and undescribed

Table V-13 Estimated miles of historic trails by counties, Green River Basin, Wyoming

Trail name	Counties: Lincoln	Sublette	Sweetwater	Uinta	Carbon	Basin total
Astorian Route (Stuart Party)		122				122
Cherokee Trail			31		18	49
Demsey Cutoff	29					29
Green River - South Pass Stage		9	67			76
Hams Fork Trail	42		5			47
Kinney Cr. Cutoff	17		30			47
Lander Cutoff	7	78				85
Mormon Emigrant Oregon Trail		17	82	41		140
Old Emigrant Trail	30		72	48		150
Overland Trail			126	46	110	282
Point of Rocks - South Pass Stage		4	45			49
Sublette Cutoff Oregon Trail Cutoff	54		52			106
Other Trails	53	51	2	30		136
Total	232	281	512	165	128	1,318

Table V-14 Historic site inventory by county, Green River Basin, Wyoming

County	Buildings or structures	Sites	Buildings, sites or structures on National Register of Historic Places
Carbon	2	2	1
Fremont		1	1
Lincoln	3	23	1
Sublette	5	16	4
Sweetwater	19	30	3
Uinta	14	12	4
Total	43	84	14

FIGURE V-23

HISTORIC SITES AND TRAILS

GREEN RIVER BASIN
WYOMING

MAY 1978

Source:
Base map prepared by SCS, WTSC Carto Staff from Sublette Investigation MOP Team Cooperative River Basin Survey Map, 1:500,000.
Thematic detail compiled from Wyoming State Historic Society, 1976 and Sweetwater County Historic Society, 1976.

Cooperative River Basin Studies
State Engineer, Wyoming Water Planning Program

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

M7-N-22953-24

are many fossil deposits. Found to date, however, are some of the richest vertebrate fossil deposits in the world. The more significant fossil search areas are located on an estimated 3,565,000 acres.

Investigation and recording thus far describe large fossil bearing tracts. Tracts are described and mapped in paleontological literature as fossil rich areas. It is estimated that 2,009,000 acres of fossil rich areas have been adequately investigated and described. Significance ratings of fossil rich areas are shown in Table V-15.

Table V-15 Significance ratings of fossil rich areas by county, Green River Basin, Wyoming

Significance rating 1/	County					Basin total
	Lincoln	Sublette	Sweetwater	Uinta	Carbon	
	1000s of acres					
10	-	-	-	-	-	-
9	3.1	-	577.3	393.6	3.1	977.1
8	-	22.4	739.8	-	32.4	794.6
7	-	99.7	-	-	-	99.7
6	11.2	-	9.4	-	3.7	24.3
5	-	-	40.0	-	-	40.0
4	3.1	3.2	-	-	-	6.3
3	-	-	24.9	-	-	24.9
2	-	3.1	38.6	-	-	41.7
1	-	-	-	-	-	-
				Total		2,008.6

1/ Significance rating: 10 - most significant fossil bearing strata; 1 - least significant fossil bearing strata.

Resource Use and Potential

Population

The 1970 census showed a total population of 51,240 for the five county area in southwestern Wyoming. This total was down 3.57 percent from 1960 and down 9.54 percent from 1950. The entire decrease was in the rural farm and non farm populations. Urban population has increased steadily from 21,603 in 1940 to 28,328 in 1970.

Population estimates for the Green River Basin hydrologic boundary are shown in Table V-16. These estimates are based on information from the Census of Population, employment data, information from county and city planners, and other state and county agency personnel.

Table V-16 Population estimates 1940 - 1973, Green River Basin, Wyoming

County	1940	1950	1960	1970	1973
Carbon 1/	690	710	642	568	600
Lincoln 1/	4,431	3,350	3,301	3,437	3,563
Sublette	2,778	2,481	3,778	3,755	3,783
Sweetwater	19,407	22,017	17,920	18,391	29,500
Uinta 1/	2,512	2,107	1,958	2,136	2,641
Basin total	29,821	30,665	27,599	28,287	40,087

1/ Partial county estimates.

Total population in the basin changed very little between 1940 and 1970, although some fluctuations did occur. Most of the fluctuations level of activity by the Union Pacific Railroad and mining industry. The sizable increase in population between 1970-1973 was caused by the increase in mining activities, gas and oil exploration, and construction of electrical power generating facilities. By 1975, the basin's population was estimated to be 44,500.

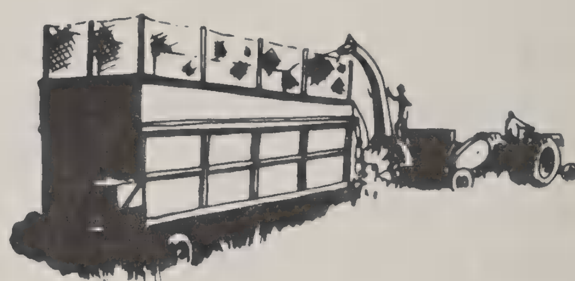
In 1970 only one community in the basin had a population greater than 10,000--Rock Springs with 11,657. Three communities--Rock Springs, Green River, and Kemmerer--contained 64 percent of the population in the basin in 1970. This percentage is even higher currently because most of the population increase has settled in or near these three communities.

The Economic Basin Working Paper (3) provides more detailed information on population and employment.

Employment

Total employment in the basin was estimated to be 10,668 in 1970 (Table V-17). This total is nearly identical to 1960 but down 10.6 percent from 1950. Almost all of the decrease in employment occurred in agriculture, forestry, mining, and transportation. The service industry and government had increases in employment.

Historical employment data for the basin are not generally available. However, from the fragments of data available, relative changes in employment levels in the five county area are good indicators of changes in the basin. Agriculture employment in the five county area decreased from 4,099 in 1940 to 1,988 in 1970 or 51.5 percent. Agricultural employment fell from a 23.5 percent share of total employment in 1940 to 10.5 percent in 1970. Productivity gains through farm-ranch consolidations, mechanization, and other technological innovations have reduced the demand for labor.



Although mining employment is relatively small in national employment figures, it is an important source of employment in the Green River Basin. Mining employment decreased from 3,824 to 2,285 or 40 percent between 1940 and 1970, but it was still the fourth largest employer in the five county area in 1970. Since 1970, mining employment has increased rapidly and will continue to grow in importance.

By far the largest employer is the service sector. Service employment increased from about 2,716 in 1940 to 4,851 in 1970 and accounts for 23.3 percent of total employment. This rapid employment growth in services reflects increased personal income, expanded economic and business activity, and increasing demand by consumers for services. An important factor for increased service employment has been the demand by nonresidents for tourist and outdoor recreational facilities.

Transportation

Transportation facilities within the basin include railroads, airlines, and county, state, and federal roads. The Union Pacific Railroad (U.P.) is the only rail line serving the basin. The U.P. double track system crosses the lower third of the basin from east to

Table V-17 Estimated employment and comparison to five county data by industry subsectors, 1970, Green River Basin, Wyoming

Industry	Green River Basin 1/ Number employed	Green River Basin 1/ Percent of total	Five county area 2/ Number employed	Five county area 2/ Percent of total
Total employment	10,668	100.00	18,972	100.00
Agriculture & forestry	980	9.20	1,988	10.50
Mining	1,800	16.80	2,285	12.00
Construction	806	7.50	1,284	6.80
Transportation, communications & utilities	1,142	10.80	2,357	12.40
Wholesale trade	138	1.30	277	1.50
Retail trade	1,895	17.80	3,289	17.30
Finance, insurance & real estate	233	2.20	400	2.10
Services	2,487	23.30	4,851	25.60
Government	438	4.10	894	4.70

1/ ESCS, Lincoln. Based in part on 1970 Census subdistrict data provided by the Manpower Administration, U. S. Department of Labor.

2/ Carbon, Lincoln, Sublette, Sweetwater and Unita Counties.

west and serves the major communities of Rock Springs and Green River. The U.P. system also serves Kemmerer and several other smaller communities. Amtrack uses U.P. facilities to serve Rock Springs and Green River. Only one community in the basin has regularly scheduled air service--Rock Springs which is served by Frontier Airlines. However, small plane charter service is available in several of the other communities.

Interstate highway I-80, which closely parallels the old Overland Trail stagecoach road and the U.P. Railroad, crosses the lower portion of the basin. Paved U.S. highways 180 and 187 connect communities in the northern part of the basin with the interstate highway and the railroad. There is also a network of interconnecting state highways and secondary roads and numerous jeep roads that give access to most areas. Tranportation facilities and roads are estimated to utilize 53 square miles of the basin's land area.

Land Ownership and Administration

Fifty-nine percent, or 7,962,610 acres of the basin, is administered by the Bureau of Land Management; 10 percent, or 1,404,290 acres, by the Forest Service; and 2 percent, or 232,300 acres, by the Bureau of Reclamation. Private land accounts for 25 percent, or 3,366,000 acres; and the State of Wyoming owns 4 percent, or 506,300 acres. Table V-18 displays land uses and total areas of each use. Land status for the basin is shown in Table V-19 and Figure V-24.

Disposal of public lands over the years by the federal government has, in some circumstances, created unusual land ownership patterns and land management problems. An example of this is the alternate section land grants given to the railroad companies in the 1860's as an incentive for the construction of a railroad. This grant gave the railroad companies every odd section in a 40-mile wide strip across the western states. Every even section was retained by the federal government. Additionally, two sections--16 and 36--were granted to Wyoming when it became a state in 1890.

Mineral Production

Trona or sodium carbonate has been produced in the Green River Basin since 1946, but only in the last 10 years has Green River trona captured a significant percentage of the nation's supply of soda ash. As of 1974, the three mines had a total output of 7 million tons. Mined trona or sodium carbonate is slowly replacing synthetic soda ash produced by the Solvay process (32).

Wyoming's reserves of oil shale are located entirely within the Green River Basin. Sixty-two percent of these oil shale lands are federally owned. Total acreage of oil shale lands, including federal, private, and state, is about 4,260,000. It is estimated 30 billion barrels could be recovered from the oil shale formations. The Tipton Tongue of the Green River Formation in Wyoming contains the richest concentration of oil found in oil shale. Yields average 13.3 gal./ton, but some run as high as 22.4 gal./ton of shale.

Table V-18 Land classifications and principal uses, Green River Basin, Wyoming

Classifications	Principal uses	Acres
Crop, hay and pasture land	Pasture, tame hay, meadow hay, small grains	336,100
Rangeland 1/	Grazing, recreation, watershed, wildlife	10,817,100
Forest land	Forest products, recreation, scenery, wildlife, grazing watershed, wilderness	1,740,000
Lentic water	Flood control, irrigation water, recreation, scenery, industry, wildlife, and wilderness	83,400
Cultural improvements	Towns, roads, railroads, industries, airports	39,000
Other (rock, sand dunes, alpine, playas)	Scenery, wilderness, wildlife	455,900
Total		13,471,500

1/ Includes non-cropped meadow lands.

Table V-19 Land ownership status, Green River Basin, Wyoming

Planning area and county	Land area	Water area	Total area	Ownership or administration: Bureau of Land Management	Forest Service	Bureau of Reclamation	State Game and Fish	Other state of Wyoming	Private
AREA I									
Lincoln	374,900	8,600	383,500	210,300	87,780	13,940		17,080	54,400
Sublette	2,275,100	29,800	2,304,900	825,490	863,640	400	8,870	41,400	565,100
Sweetwater	4,000	-	4,000	3,100	-	900	-	-	-
Teton	6,100	100	6,200	-	6,200	-	-	-	-
Subtotal	2,660,100	38,500	2,698,600	1,038,890	957,620	15,240	8,870	58,480	619,500
AREA II									
Fremont	58,400	-	58,400	53,380	-	-	-	1,920	3,100
Lincoln	1,000	-	1,000	1,000	-	-	-	-	-
Sublette	549,700	1,000	550,700	458,140	51,290	4,470	-	26,900	9,900
Sweetwater	3,265,630	18,770	3,284,400	2,017,860	45,090 2/	106,200	-	157,220	958,030
Subtotal	3,874,730	19,770	3,894,500	2,530,380 1/	96,380	110,670	-	186,040	971,030
AREA III									
Lincoln	856,000	1,600	857,600	598,800	74,780	2,000	-	30,800	151,220
Sweetwater	970,420	16,580	987,000	530,020	50,430 2/	103,250	-	23,000	280,300
Uinta	1,027,500	2,000	1,029,500	565,680	37,760	440	-	34,800	390,820
Subtotal	2,853,920	20,180	2,874,100	1,694,500 1/	162,970	105,690	-	88,600	822,340
AREA IV									
Carbon	525,500	300 3/	525,800	311,900	-	-	-	17,300	196,600
Fremont	90,200	-	90,200	81,820	-	-	-	7,680	700
Sweetwater	1,881,200	3,900 3/	1,885,100	1,339,140	-	-	30,430	40,400	475,130
Subtotal	2,496,900	4,200	2,501,100	1,732,860	-	-	30,430	65,380	672,430
AREA V									
Carbon	974,300	700	975,000	539,700	187,320	700	-	63,580	183,700
Sweetwater	528,200	-	528,200	426,280	-	-	-	4,920	97,000
Subtotal	1,502,500	700	1,503,200	965,980	187,320	700	-	68,500	280,700
Basin Total	13,388,150	83,350 4/	13,471,500	7,962,610	1,404,290	232,300 5/	39,300 6/	467,000 7/	3,366,000

1/ BLM lands include portions of 22,000 acres of the Seedskadee National Wildlife Refuge in Subbasins II & III.
2/ Acres are Flaming Gorge National Recreation Area.
3/ Some of these lakes are intermittent.
4/ State Report No. 3, Water and Related Resources of Green River Basin gives 69,800 Comprehensive Framework Study 1969, prepared by Federal Interagency Team, gives 88,000.
5/ Source: Bureau of Reclamation. Includes acquired and withdrawn land.
6/ Additionally, the Game and Fish leases 89,300 acres from private and federal sources.
7/ Combined total for the state of Wyoming of 506,300 acres is far below total given in Comprehensive Framework Study of 951,000.

Source: USDA Field Party, Green River Basin, Wyoming

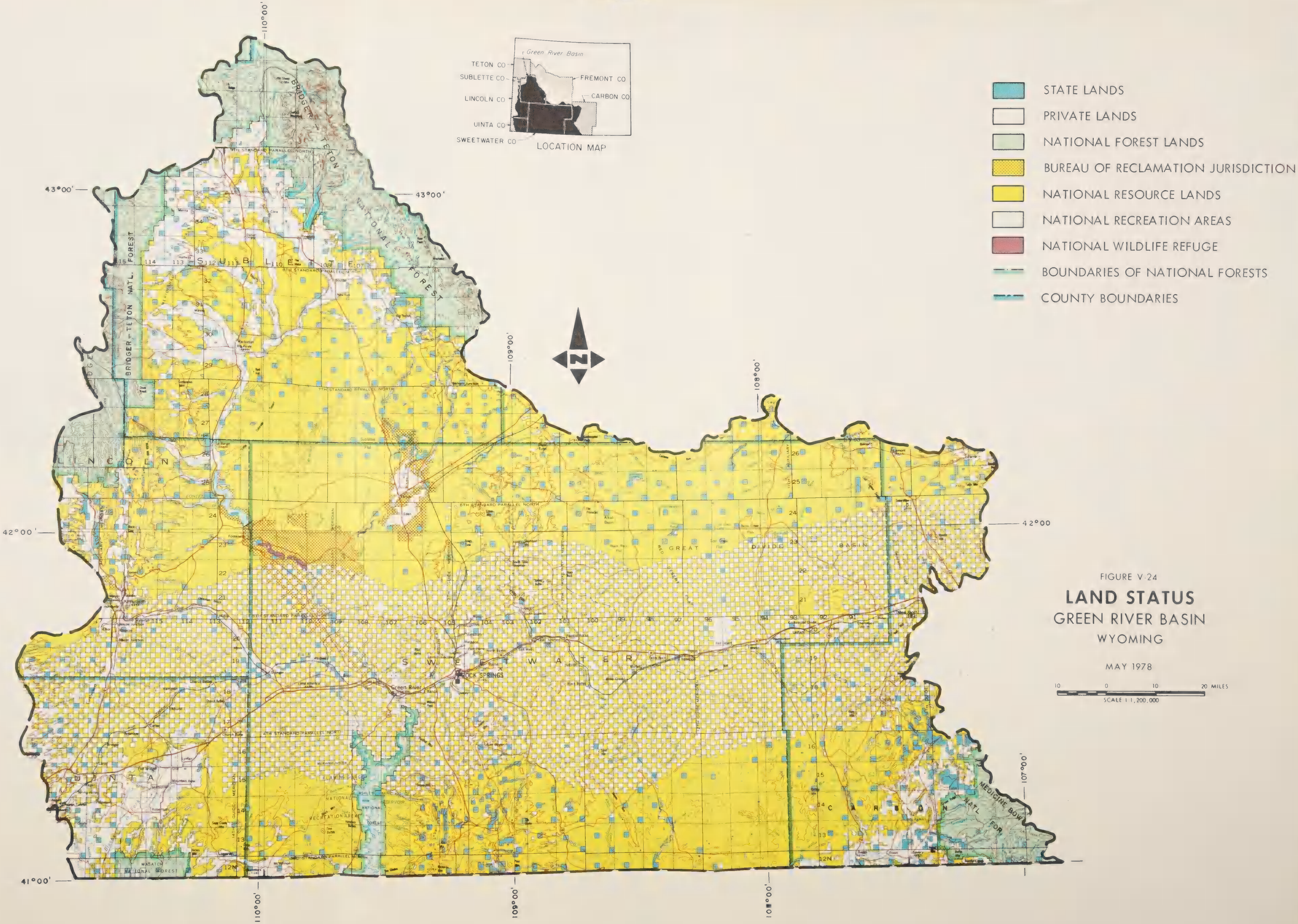


FIGURE V-24
LAND STATUS
GREEN RIVER BASIN
WYOMING

MAY 1978

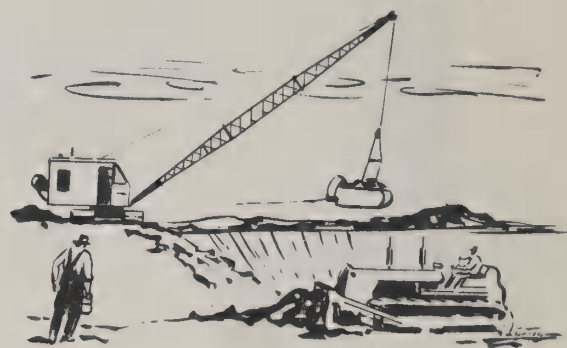
10 0 10 20 MILES
SCALE 1:1,200,000

Trona mine and processing plant north of the town of Green River
Soil Conservation Service

Natural gas and natural gas liquids are the economic leaders in the basin. A report released in December of 1972 indicates the Green River Basin has the potential of becoming the "most important gas producing area in the Rocky Mountain Region." Natural gas production in 1974 totaled 161.9 (MMCF) valued at $39.7 million. Natural gas liquids produced in 1967 totaled 4,214 thousand barrels valued at $9.1 million. Since that time, production has increased. Most of the rise was in LP (liquid petroleum) gases.

Petroleum production in the Green River Basin returns more revenue than natural gas, but trona and coal have higher revenue potential from future development. Petroleum production for 1974 was 12.7 million barrels valued at an estimated 82.9 million dollars. There are four major oil fields which produced a little over 5 percent of the State's total yield. Projections to the year 2020 by Cameron Engineers indicate crude oil production will steadily decline (32).

Coal is projected to be a major resource industry in the Green River Basin. In 1974, coal production was 4.1 million tons (33). Most of the coal produced will be used for electric generation plants and coking plants located within the basin. Two large power plants are Viva Naughton and Jim Bridger. Both power plants will eventually produce in excess of 3,500 megawatts of electricity. This will require large amounts of coal. In 1967, original reserves were estimated at 19,790 million tons with remaining reserves estimated at 19,170 million tons.



The potential for uranium mining and processing the the basin is substantial, although the extent of reserves is still not clear. Considerable exploration has been conducted and mine developments have occurred during the past year.

Sand and gravel is a significant mineral industry. In 1972, approximately 15 sand and gravel pits were operated within the basin, but production figures are unavailable.

Agricultural Resources

Livestock Production

Livestock production is by far the most important agricultural enterprise in the Green River Basin. All main livestock enterprises are cow-calf and yearlings or ewe-lamb operations. Ninety-five percent of all agricultural sales result from livestock and livestock products. Ninety-one percent of all agricultural sales are from beef cattle and sheep production (13).

Historically, sheep numbers have been considerably greater than cattle numbers. However, sheep numbers have been declining rapidly, and cattle numbers have been increasing so that by 1975 the numbers were almost equal (Figure V-25). Between 1950 and 1975, sheep numbers decreased by 51 percent while cattle numbers increased by 92 percent.

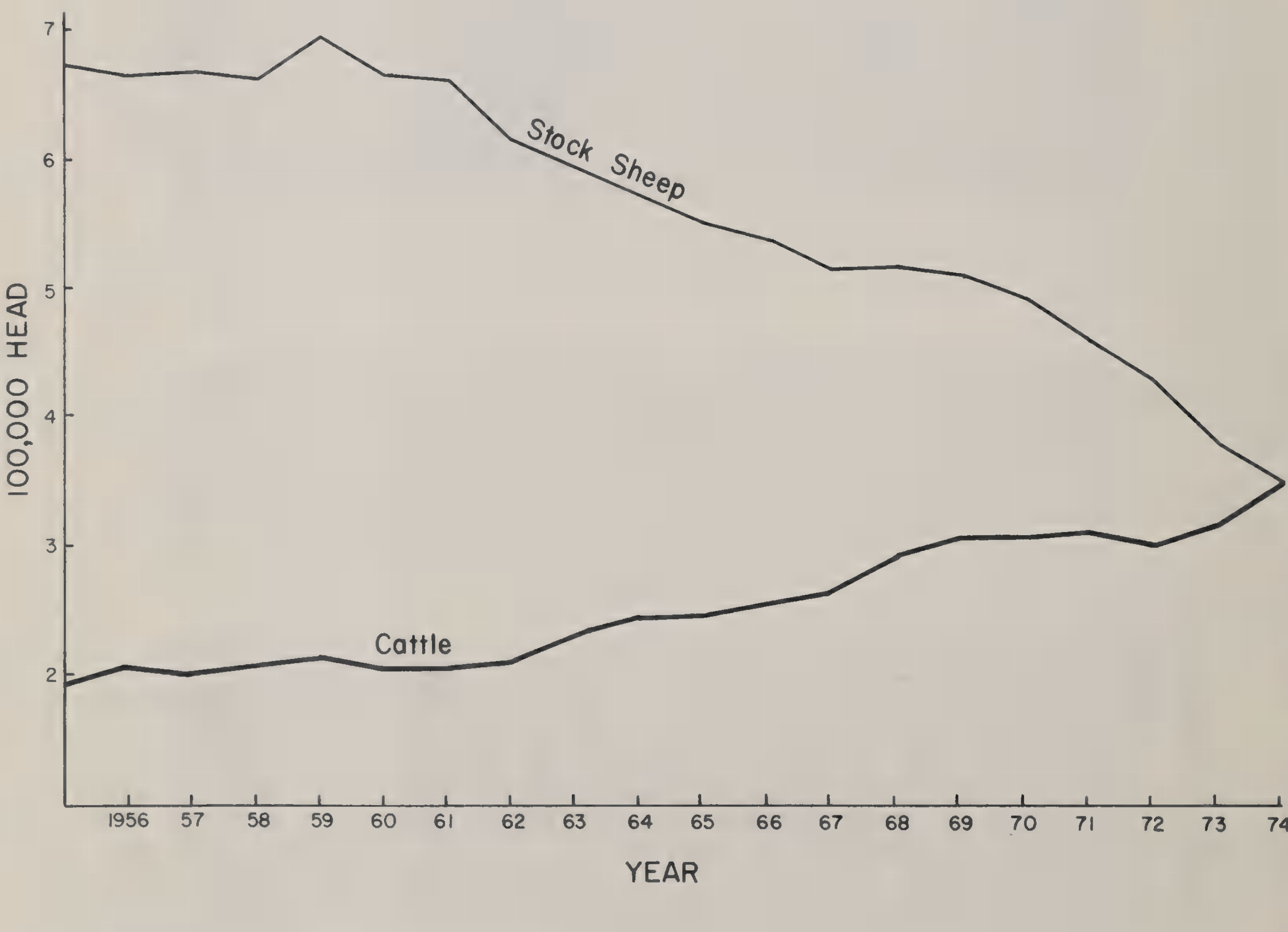
Table V-20 shows estimated livestock numbers for the hydrologic boundary of the Green River Basin for the years 1970-1975. Cattle and sheep numbers in the basin have exhibited trends similar to the five county area and the state. Beef cattle and calves in the basin make up 11 percent of the state total. Sheep numbers are 17 percent of the

Cattle grazing on summer range in Great Divide Basin
Soil Conservation Service

Sheep grazing on spring range southeast of Wamsutter
Soil Conservation Service

Figure V-25 Trends for cattle and sheep numbers, 1956-1974

Green River Basin, Wyoming [1]



[1] Numbers of sheep and cattle for entire 5 county area.

Table V-20 Livestock numbers by class, Green River Basin, Wyoming, 1970-1975

Class of livestock	1970	1971	1972	1973	1974	1975
	Year					
Beef cattle & calves	162,687	165,113	164,943	162,713	169,318 1/	189,648 1/
Dairy cattle & calves	1,825	1,650	1,256	1,167	1,212	1,152
Stock sheep	284,520	275,435	255,295	256,675	227,750	204,040
Swine	330	350	320	250	200	N.A. 2/
Horses and ponies	5,692	N.A.	N.A.	8,170	N.A.	N.A.
	Percent of state					
Beef cattle & calves	11.0	11.0	11.0	10.0	11.0	11.0
Dairy cattle & calves	9.0	9.0	7.5	7.0	7.5	N.A.
Stock sheep	17.0	16.0	16.0	17.0	17.0	17.0
Swine	0.6	0.6	0.5	0.5	0.5	N.A.
Horses and Ponies	13.4	N.A.	N.A.	13.5	N.A.	N.A.

1/ These exceptionally large annual increases were apparently caused by ranchers holding larger than "normal" numbers of calves and yearlings in hopes of improved prices. Preliminary data for 1976 indicates that beef cattle and calf have adjusted back down to around 172,000 head.

2/ N.A., data not available.

Source: Wyoming Agricultural Statistics January 1 County Inventory data prorated to the hydrologic boundary.

state total. Swine compose less than one percent of the state total, and horses 13-14 percent of the total in the state.

Crop, Hay and Pasture Production

All successful crop production in the Green River Basin is dependent on irrigation. Because of climatic and soil characteristics discussed earlier, 95 percent of all acreage is devoted to hay and pasture production. Both of these crops are essential to the large livestock sector.

Harvesting improved hay near LaBarge
Soil Conservation Service

Harvesting improved hay near LaBarge
Soil Conservation Service

Small grain production in the basin is limited to small acreages of barley and oats. Small grains harvested for grain over the past nine years have averaged 3,585 acres annually. Most small grains are planted as a nurse crop in establishing or renovating hay and pasture lands.

Total production of hay and pasture converted to AUMs is 1,242,900. This is only 61 percent of potential production, given present land and water supply, assuming all hay and pasture lands were adequately treated. Presently an estimated 40,500 acres of irrigated land are considered adequately treated. Treatment is not feasible on 130,900 acres(Table V-21).

Average pasture and hay yields are shown in Table V-22. The yields shown in the table are 5-year averages. Yields are reasonably uniform across the basin, and the year-to-year variations have been relatively small. Trends in yields have been upward over the past 10-15 years, but the rates of increase have been very modest.

Table V-21 Land treatment status for irrigated lands, Green River Basin, Wyoming

	Planning Areas				
Treatment status	I	II	III	V	Total basin
Adequately treated	22,300	5,600	9,000	3,600	40,500
Needing treatment	124,800	10,100	26,200	3,600	164,700
Treatment not feasible	58,300	6,400	59,000	7,200	130,900
Total irrigated	205,400	22,100	94,200	14,400	336,100

Table V-23 presents the distribution of irrigated land in the Green River Basin with hay and pasture predominating. Although Table V-23 shows estimates for both hay and pasture, the distinction between the two is not usually clear-cut from ranch to ranch, or even from field to field, or from year to year. Very often the type of feed needed and the water supply will influence whether hay or pasture is harvested. Irrigation water is occasionally short, especially in the Big Piney area, and exerts a strong influence on the crop yield. Late season irrigation water shortages are estimated to involve 60,700 acres of land totaling 27,420 acre-feet of water. Table V-24 gives the acres of irrigated land with adequate or inadequate water supplies by watersheds for the 80 percent chance water yield (9).

Forage production has increased over the past 10-15 years as a result of improved hay and pasture yields, increases in the acreage of improved hayland, and better management of water supplies. Improved hay acreages increased from an estimated 57,500 acres in 1965 to 72,850 in 1974 (30).

Table V-22 Irrigated forage crops, yields, and total production by planning areas, 1974-75, Green River Basin, Wyoming

Planning area	Pasture and hayland				Yield			Total production		
	Tame hay	Native hay	Pasture	Total acres 1/	Tame hay	Native hay	Pasture	Tame hay	Native hay	Pasture
					tons	tons	AUMs	tons	tons	AUMs
I	36,800	101,355	65,390	203,545	1.8	1.0	3.15	66,240	101,355	204,665
II	16,260	1,200	3,470	20,930	2.0	1.0	3.30	32,520	1,200	11,450
III	18,400	28,545	47,345	94,290	1.9	1.0	2.75	34,960	28,545	130,200
V	1,400	10,050	2,300	13,750	2.65	1.14	4.00	3,710	11,460	9,200
Total	72,860	141,150	118,505	332,515	1.89 2/	1.01 2/	3.00 3/	137,430	142,560	355,515

1/ Does not include small grain harvested for grain.
2/ Weighted average yields for the basin.
3/ Weighted average yields. Revised upward from the working paper to a more realistic production.

Source: Wyoming Agricultural Statistics, SCS Field Offices and field surveys.

Table V-23 Distribution of irrigated acres by crop, 1970-74 average, Green River Basin, Wyoming

Crop	County [1/]					Basin total
	Carbon	Lincoln	Sublette	Sweetwater	Uinta	
	acres					
Hay						
Alfalfa	1,400	3,700	10,180	11,680	3,000	29,960
Other hay	10,050	12,480	119,250	9,770	32,500	184,050
Improved	—	510	19,070	8,570	14,750	42,900
Native	10,050	11,970	100,180	1,200	17,750	141,150
Total hay	11,450	16,180	129,430	21,450	35,500	214,010
Pasture	2,300	7,220	59,280	5,580	44,125	118,505
Small grains						
Wheat	—	—	—	—	60	60
Barley	150	200	200	470	450	1,470
Oats	500	200	390	700	265	2,055
Total grains	650	400	590	1,170	775	3,585
Total irrigated acres	14,400	23,800	189,300	28,200	80,400	336,100

1/ County data adjusted to hydrologic boundary.

Source: Wyoming Water Planning Program Office, Report No. 3; SCS Field Offices; U.S. Census of Agriculture, 1969, and Statistical Reporting Service Data, 1970-1974.

Table V-24. Acres of irrigated land with adequate or inadequate water supply and acre-feet short by watersheds investigated and planning areas, Green River Basin, Wyoming

Planning areas and watershed	Irrigated acres 1/	Present conditions: Acres with adequate supply	Present conditions: Acres without adequate supply	Diversion shortage acre-feet short
I				
East Fork	8,260	7,460	800	60
Muddy Creek at East Fork	1,185	1,185	0	-
Silver and Spring Creeks	2,174	1,496	678	210
Boulder Creek	9,909	9,909	0	-
Fall Creek	1,848	1,291	557	380
Pole Creek	3,340	3,340	0	0
Pine Creek	9,240	9,240	0	-
New Fork from lake to mouth of Willow Creek	14,300	14,300	0	-
Willow and Lake Creek	4,910	4,910	0	-
New Fork, below Pinedale	6,187	6,187	0	-
New Fork Paradise Canal	2,200	1,465	735	1,270
Beaver Creek	8,369	82	8,287	4,420
Horse Creek	15,920	669	15,251	4,860
Cottonwood Creek	20,000	20,000	0	-
North Piney Creek	17,034	5,011	12,023	2,210
Middle and South Piney Creek	19,400	2,440	16,960	12,460
Dry Piney Creek	420	84	336	110
LaBarge Creek	7,857	7,857	0	-
Fontenelle Creek	3,491	3,491	0	-
III				
Hams Fork	11,715	11,715	0	-
Muddy Creek - (Blacks Fork)	2,716	252	2,464	900
Henrys Fork	17,627	17,627	0	0
V				
Little Snake River	14,400	11,796	2,604	540
TOTAL 2/	202,502	141,807	60,695	27,420

1/ Does not include Big Sandy and the Lyman-Mountain View irrigated areas.

2/ There is no irrigated land in Planning Area IV.

On the other hand, total animal unit equivalents in the basin, except for year to year variations, have remained relatively constant at about 232,000. However, there has been a dramatic shift from sheep to cattle production. This shift has created a need for more winter feed, but with the increase in hay and rangeland production a general winter feed shortage has not developed. If the shift from sheep to cattle production continues without a corresponding increase in winter forage, winter feed supplies could become critical.

With the same acres and water supply, there is a significant potential for increased forage production. All irrigated land, however, will not respond to the seeding of higher yielding crops or better agronomic practices. There are several problems associated with any effort undertaken to reach production potential. Out of the 336,100 acres presently irrigated, 61 percent, or 205,200 acres, will react favorably to improved treatment. The principal problems for the remaining 130,900 acres relate to type of soils and their management, availability of irrigation water, and irrigation management practices. The following sections briefly discuss the major problems.

Soils

Intrinsic properties of some of the irrigated soils prohibit any intensified farming operations on about 40 percent of the irrigated area. Another 27 percent of the irrigated lands have only a moderate potential for improvement, and about 33 percent have a good potential. Table V-25 gives the acres by planning areas that have a high or medium potential for improvement. Also, the potential yields are given for the soil capability groups.

Soils are shallow to moderately deep over underlying saline-alkali shales. Other soils are underlain by mixed gravels, cobbles, and stones. Many soils are well drained with low available water capacities. Some soils are gravelly or cobbly, low in fertility, and have a rapid to moderately rapid water permeability rate. A few soils have slopes too steep for intensified farming. Saline-alkali conditions are common in some locations. In summary, the most limiting soil properties for crop production are shallowness, gravelly or cobbly profiles, saline-alkali conditions, and low available water capacities.

Irrigation Management

Whereas poor soils inhibit yields for hay and pasture production, many of the irrigation practices commonly used further compound forage production problems. The basin irrigation method used is flooding hay and pastureland from streamflow diversions. Although flooding is the least costly approach in terms of time and cash expended, this technique usually results in excessive water applications and has adverse effects on forage production.

Table V-25 Levels of production potential for irrigated acres by planning areas, Green River Basin, Wyoming

Levels of potential yield 1/	Planning areas				Estimated potential yields per acre				
	I	II	III	V	Alfalfa hay	Improved grass-hay	Improved native hay	Improved pasture	Improved native meadow pasture
	--------Acres irrigated-----------				Tons			AUMs	
High 2/	90,700	5,500	15,300	5,000	4.0	3.0	1.5	5.0	3.0
Medium 2/	56,400	10,200	19,900	2,200	2.5	2.0	1.0	3.5	2.0
Low	58,300	6,400	59,000	7,200	---	---	---	---	---
Total irrigated	205,400	22,100	94,200	14,400					

1/ Levels of potential yield by land capability classes. Land capability classes are used by the Soil Conservation Service to provide a means of grouping soils which are alike in their response to management and treatment.

2/ High and medium potential yields occur on soils with map unit designations of BF-5, MC-10, and MF-3. See soils descriptions on page V-6 and Appendix Table A-5.

Excessive irrigation water application near Daniel
Soil Conservation Service

Some of the more important adverse effects are:

1. Excessive water applications limit the types of plants that can be grown to native sedges, rushes, and other highly water tolerant species. These species are low producers and tend to be less palatable.

2. Soil nutrients are more rapidly leached out of the soil profile.

3. Over-irrigation can cause a perched water table over saline-alkali shales. This often brings saline-alkali salts to the surface where they concentrate after surface water evaporates. This salinity build-up reduces crop yields. Continued over-irrigation causes return water flows to be higher in dissolved solids due to leaching of the saline-alkali shales.

4. Soil temperatures are kept relatively low from flood irrigation and early season applications. Essentially no plant growth takes place until soil temperatures rise above 41^{o}F. Wet soils warm much more slowly than drier soils. When cold irrigation water, which usually does not reach 40^{o}F until mid-June, is applied, soil temperatures are very slow to reach levels for maximum plant growth. The species of grass that can be grown and yields are severely restricted.

Range Production

Using range condition classes and total acreage in conjunction with initial stocking rate, estimates of range production for use by livestock and wildlife were made. Estimated present rangeland production in animal units months (AUMs) is shown in Table V-26. Twenty-five percent of the rangeland is owned by ranchers or other individuals. The remaining 75 percent is owned by the federal government, state government, or the Union Pacific Corporation.

The measure of range utilization and production is the animal unit month (AUM). An AUM is the amount of feed or forage required to support a mature 1,000 pound cow with a 400 pound calf at her side for one month, or 26 pounds of dry forage matter per day. All other types of livestock and wildlife feed requirements are measured relative to this base. For example, one mature sheep requires one-fifth of the daily requirement of 26 pounds of dry matter.

An estimated 3,327,900 acres of rangeland are adequately treated. The remaining 8,476,300 acres need treatment to improve production and utilization, and to reduce erosion. Table V-27 presents the acres adequately treated and those needing treatment by planning areas.

Through rangeland improvement programs and the institution of grazing management systems, which includes extensive water development for livestock, it is estimated an additional 690,300 AUMs could be produced on the BLM, private, and state lands. This amounts to a 40 percent greater production over current levels. Table V-28 gives the acres of present and potential production by precipitation zones and groups of range sites.

Estimated production on National Forests is 103,600 AUMs. Permits have been issued for 128,900 AUMs, but not all of the permittees are exercising their allotment. Therefore, permitted use is granted at 25,300 AUMs above estimated production. However, actual use on National Forests is 94,500 AUMs. Figure V-26 indicates there will be a decline in range production with the present programs. Potential forage production for 2020 is estimated at 106,800 AUMs with the initiation of range improvement programs. This is 12,300 AUMs above present use, but only 3,200 AUMs above present production.

Total present rangeland production in the basin is more than adequate to meet present livestock and wildlife feed demands and appear to be adequate for quite some time in the future. However, there are several problems related to the efficient and orderly utilization of rangeland.

Table V-26 Estimated present rangeland acres and AUMs by ownership and planning area, 1974-1975, Green River Basin, Wyoming

Planning Area	Private			Bureau of Land Management Lands[1/]			Forest Service Lands			Total		
		AUMs			AUMs [2/]			AUMs [2/]			AUMs	
	Acres	Cattle	Sheep	Acres	Cattle	Sheep	Acres	Cattle	Sheep	Acres	Cattle	Sheep
I	370,900	238,500	--	1,121,300	135,000	780	389,760	73,200	21,520	1,881,960	446,700	22,300
II	49,370	9,870	2,600	3,572,830	202,600	193,000	27,040	--	5,470	3,649,240	212,470	201,070
III	156,960	57,020	7,300	2,448,200	138,300	110,400	65,940	5,400	4,910	2,671,100	200,720	122,610
IV	--	--	--	2,384,000	135,800	260,590	--	--	--	2,384,000	135,800	260,590
V	155,190	51,190	10,700	972,560	75,000	86,400	90,130	10,050	8,320	1,217,880	136,240	105,420
Total	732,420	356,580	20,600	10,498,890	686,700	651,170	572,870	88,650	40,220	11,804,180	1,131,930	711,990

1/ Includes acres and AUMs for state and BLM lands; for railroad lands and former railroads that lie within the checkerboard land area.

2/ AUMs on BLM and Forest Service lands represent grazing permits.

Table V-27 Land treatment status of rangeland, Green River Basin, Wyoming

Ownership and land treatment status	Planning areas				
	I	II	III	IV	V
Private and state 1/					
Rangeland area	370,900	1,086,100	815,600	760,200	304,800
Adequately treated	192,900	50,000	14,000	440,000	202,400
Treatment needed	178,000	1,036,100	801,600	320,200	102,400
Bureau of Land Management 2/					
Rangeland area	1,121,300	2,536,100	1,789,600	1,623,800	823,000
Adequately treated	356,100	84,000	64,200	1,386,000	244,400
Treatment needed	765,200	2,452,100	1,725,400	237,800	578,600
Forest Service 3/					
Rangeland area	389,800	27,000	65,900	--	90,100
Adequately treated	264,000	9,600	2,000	--	18,300
Treatment needed	125,800	17,400	63,900	--	71,800
Basin TOTALS					
Rangeland area	1,882,000	3,649,200	2,671,100	2,384,000	1,217,900
Adequately treated	813,000	143,600	80,200	1,826,000	465,100
Treatment needed	1,069,000	3,505,600	2,590,900	558,000	752,800

1/ SCS Records and Reports
2/ BLM Unit Resource Analysis Reports
3/ Forest Service Range Improvement Inventory Reports

Table V-28 Present and potential rangeland production by production groups and range sites, Green River Basin, Wyoming

Production group 2/	Range sites 1/	Acres	Present production AUMs	Potential production AUMs
	(7-9" Precipitation)			
A	Wetlands, Subirrigated, Saline subirrigated	14,600	15,400	19,400
B	Overflow, Saline lowland	291,600	62,100	80,200
C	Sands, Sandy, Loamy, Clayey	2,476,300	326,000	406,700
D	Dense clay, Steep loamy, Impervious clay, Saline upland	1,912,600	174,900	220,600
E	Shallow sandy, Shallow loamy, Shallow clayey, Coarse upland, Shallow breaks	1,688,400	106,900	142,900
F	Very shallow, Shale, Gravel	312,000	19,200	23,600
	(10-14" Precipitation)			
A	Wetlands, Subirrigated, Saline subirrigated	165,300	214,000	236,500
B	Overflow, Saline lowland	30,800	13,500	15,400
C	Sandy, Sands, Loamy, Clayey	1,170,100	293,300	377,200
D	Dense clay, Steep loamy, Impervious clay, Saline upland	407,700	76,800	89,100
E	Shallow sandy, Shallow loamy, Shallow Clayey, Coarse upland, Shallow breaks	1,424,300	186,100	230,800
F	Very shallow, Shale, Gravel	201,100	17,400	21,400
	(15-19" Precipitation)			
A	Wetlands, Subirrigated, Saline subirrigated	59,500	84,700	101,000
B	Overflow, Saline lowland	6,900	3,000	4,200
C	Sands, Sandy, Loamy, Clayey	307,000	127,400	150,000
D	Dense clay, Steep loamy, Impervious clay, Saline upland, Shallow breaks	178,600	53,900	70,300
E	Shallow sandy, Shallow loamy, Shallow clayey, Coarse upland	248,700	50,000	63,600
F	Very shallow, Shallow gravel	40,100	5,700	6,300
	(20-24" Precipitation)			
D	Steep loamy	140,600	77,300	77,300
E	Shallow loamy	149,600	67,300	67,300
F	Very shallow	5,500	1,500	1,500
	TOTALS	11,231,300	1,976,400	2,405,300

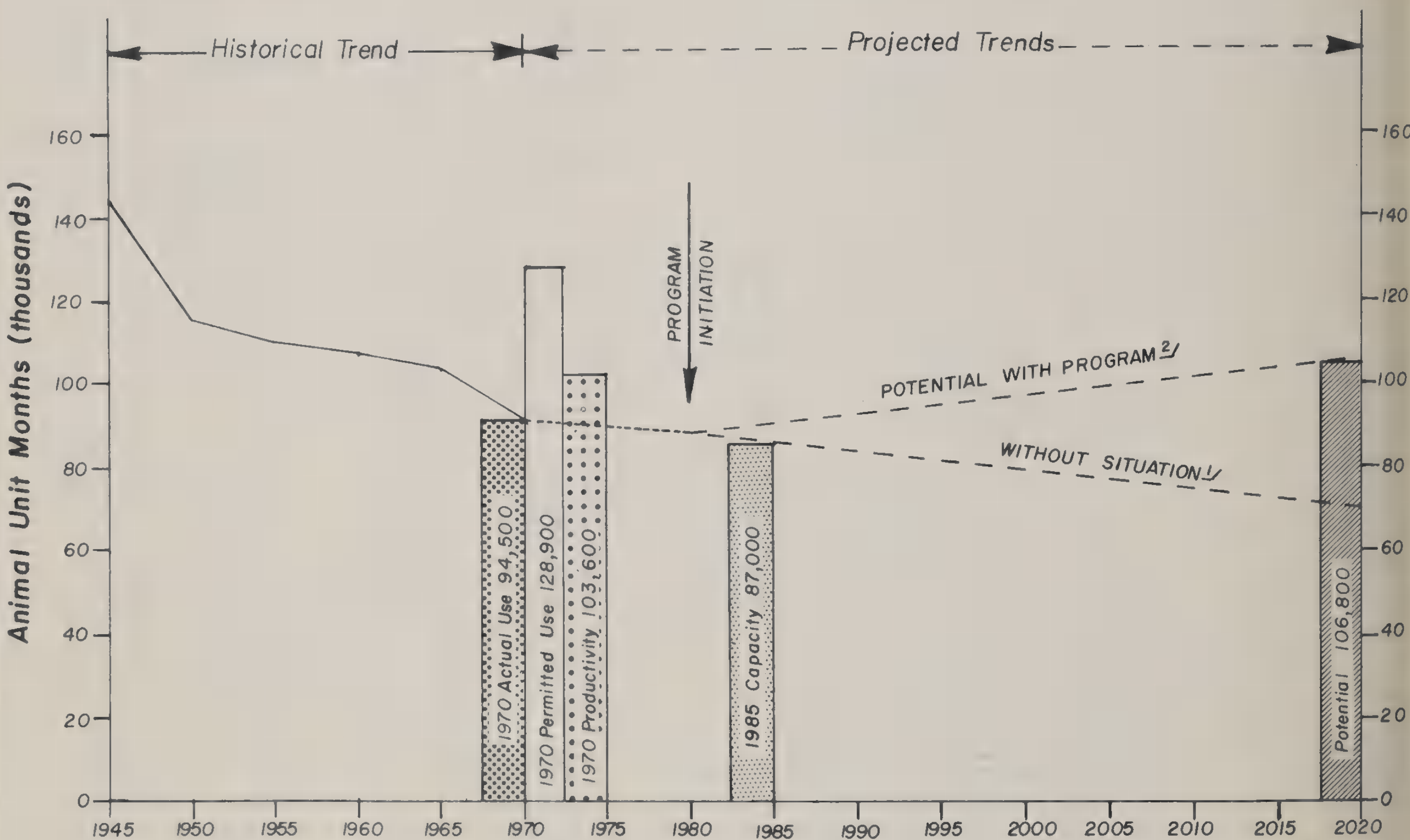
1/ Does not include National Forests.

2/ Production groups are groupings of range sites which have similar production capabilities.

Figure V-26 Past and Projected Trends in Livestock Forage and Use on National Forest Lands, Green River Basin, Wyoming

1/ The without situation assumes a continued decline due to competing uses of the land for recreation, timber and replacement of aspen with conifer of lower productivity.

2/ With program, assumes development and management at optimum level on suitable rangeland.



About 5,295,600 acres, or 45 percent, of the rangeland is in good to excellent condition. A large percentage of these acres are under-utilized. Another 5,687,240 acres (48 percent) are in fair condition, and 821,360 acres (7 percent) are in poor condition. The fair and poor condition range is due mainly to overuse by livestock. The principal reason for the imbalance in range use and resultant condition is that improved grazing management systems have not always been implemented. Major problems associated with initiation and maintenance of grazing systems are discussed briefly as follows:

Fragmented Land Ownership

A major problem of implementing a range management program is fragmented land ownership patterns. The U.S. Government owns 70 percent of the land in the basin. The Bureau of Land Management administers 8,008,100 acres, most of which is rangeland. However, scattered among BLM lands and/or adjacent to them are 2,833,000 acres of privately held lands, which include an estimated 700,000 acres of railroad checkerboard land and 467,000 acres of state land. This land ownership pattern is not congruent with criteria used when considering grazing management or range improvement plans, such as soils, amount and type of vegetal cover, precipitation, and wildlife habitat. In many instances, management plans must involve at least three major ownership categories and as such, it becomes extremely difficult to get agreement and concurrence in the management and use of rangeland.

Livestock Water

Adequate amounts and distribution of livestock water necessary for the successful husbandry of cattle on much of the rangeland is commonly deficient. About 60 percent of the rangeland is unsatisfactorily watered for cattle use. Due to the absence of water, much of the rangeland, particularly in the Little Colorado Desert Area and the Great Divide Basin, goes unused by cattle. Where water is available, particularly in small supplies at scattered locations, the rangeland is overused by cattle as well as wild horses. Insufficient livestock water, however, has had its beneficial effects on range condition. Much of the rangeland in good to excellent condition is located where summer livestock water supplies are limited or entirely lacking.

Fencing

Fencing implies the initiating of more intensive grazing management systems. More intensive grazing management is inititated mainly for two reasons: (1) to improve range and watershed conditions; and, (2) to enable the user to harvest more AUMs. Fencing is used as a

Livestock water on rangeland

Soil Conservation Service

management tool for controlled livestock grazing, especially cattle. With adequate fencing and water supplies, the rancher and the range manager are able to graze successfully much more of the usable forage without causing undue deterioration or overuse of rangeland. Research studies over the years indicate that if rangeland is in poor or fair condition, fencing, followed with the implementation of improved grazing management systems, will restore the range and watershed conditions and will eventually bring about an increase in meat production on a given range. However, if rangeland is in good to excellent condition, fencing to implement a grazing management system, without full utilization of other management practices, has resulted in less production of beef per acre at some locations.

Another important aspect of fencing as a range management tool is the potential impact on wildlife species. Fencing any of the rangelands in the Green River Basin may influence antelope movements and populations. However, fences can be planned and constructed which will result in only minimal hindrance to antelope movement. Also, in certain areas fencing would influence the movement of the unclaimed horses. Other animals, such as deer, elk, and moose, would not be significantly affected by fencing.

Because of the shift from sheep to cattle, much of the rangeland of the basin is in need of fencing into allotments of sufficient size, number, location, and shape to merit the range users to initiate more intensive systems of grazing management, but fencing probably more than any other tool of grazing management has its complexities and can bring about favorable or unfavorable results of a significant magnitude.

Wild and Free Roaming Horses

Loose, unbranded or unclaimed horses, sometimes termed wild horses, graze uncontrolled on the rangelands of the Green River Basin. These horses are one of the more serious problems of range management facing the range manager and users. Wild horses, which have no natural predators and which were until recently protected from any practical acts of harvesting or molestation by the Wild Horse and Burro Act 7/, are increasing annually at the rate of about 20 percent. Changes in regulations in October, 1976 permit the BLM to roundup the horses by helicopter. Presently there are an estimated 6,000 head grazing the rangelands of the Green River and Great Divide Basin, with most of them located in the Great Divide Basin. Their present AUM consumption is estimated at 90,000. At the time of this study, no feed has been allocated for these horses on either private or federal lands.

Yearlong water is scarce in the Great Divide Basin. With many horses competing for water, along with cattle, sheep and wildlife, the land surrounding the few of the water holes is becoming nothing but dustbeds covering several acres at each location. Additionally, numerous deep trails leading from the water holes, as spokes from the hub of a wagon wheel, extend in all directions for considerable distances giving the rangeland the appearance of severe overuse and deterioration. In the southeast area, overtrampling of the sandy textured soils has allowed wind erosion to accelerate. This condition can only worsen as

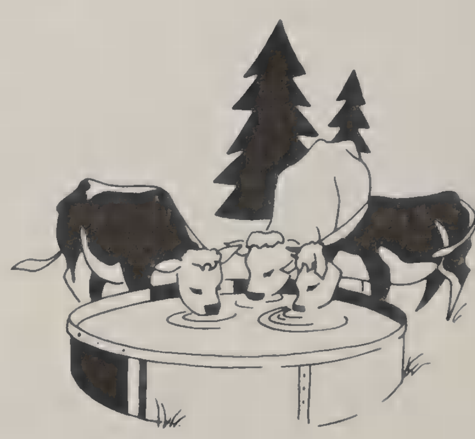
1/ Public Law 92-195, 92nd Congress, sec. 1116, December 15, 1971.

the horses become more numerous and compete with what few cattle, sheep and wildlife use the same range and water. Recent decisions made for BLM planning units have been implemented to reduce wild horse numbers.

Shifting Livestock Use - Sheep to Cattle

For many years sheep were the dominant livestock class grazing in the basin. Sheep numbers peaked about 1910 to 1912 and have been declining ever since. During the past 25 years this decline has slowed, and it may level off soon. With the decline of the prominence of sheep numbers, cattle numbers have increased.

Conversion of sheep AUMs to cattle AUMs creates many problems. For years the standard conversion has been one cow for five sheep. However, conversions today by the BLM generally have been at a much higher ratio



(i.e., less than one cow is permitted to replace five sheep). In some instances a safe conversion rate from the standpoint of the available forage is difficult to determine. This is particularly true for much of the rangeland in the Green River Basin where there is a lack of livestock water supplies in the spring and summer months. Sheep use this range in the winter months when they are able to utilize the snow for water. Hence, the converting of large areas of sheep range to cattle range within the basin is impossible without the development of more water supplies.

Other factors involved in shifting from sheep to cattle are the location of fences, ownership, topography, wildlife use and habitat, and vegetation. Additionally, vegetative cover may not always permit conversion to cattle at a constant ratio because some plant species are more palatable for sheep than cattle. An example is the desert shrub type vegetation consisting of the low sagebrushes, saltbushes, and rabbitbrushes. Sheep are able to utilize rangeland with this type of vegetation more efficiently than cattle. As cattle numbers continue to increase, further conversions of range from sheep to cattle will be required if full utilization of the range resources by livestock are to be obtained.

Timber Production

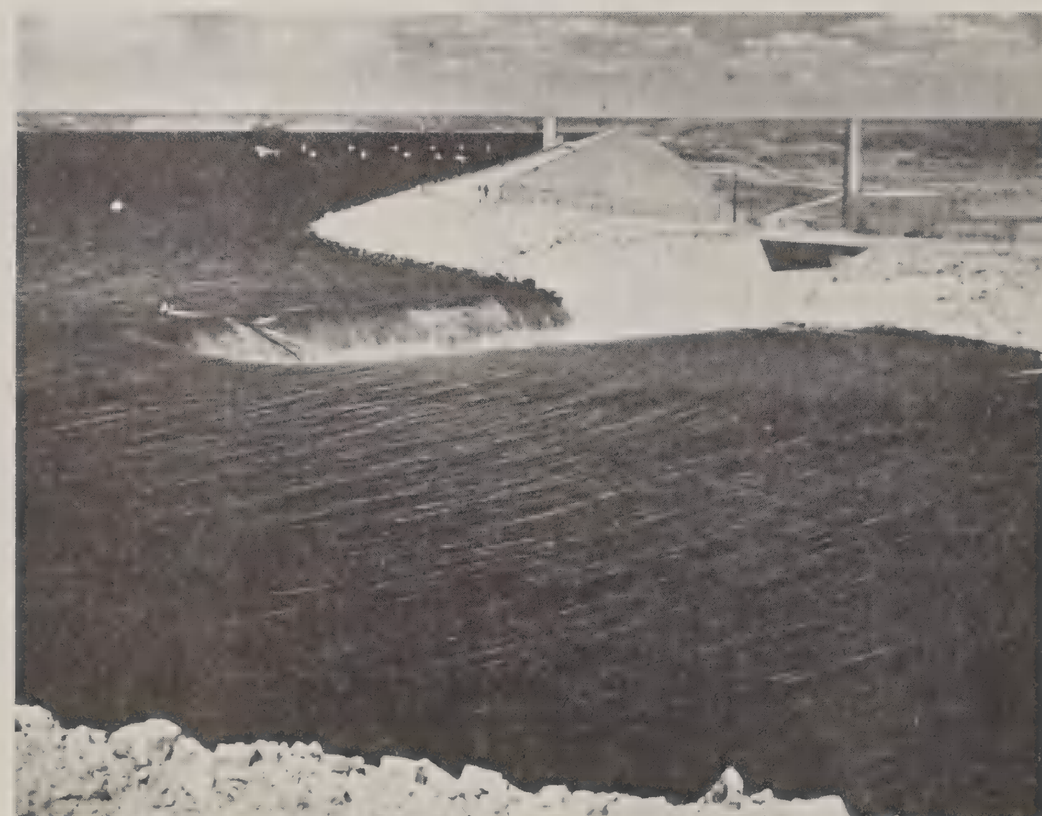
In 1970 an estimated 30.7 million board feet of sawtimber, 48,600 poles, 9,220 posts, 1,970 cords of fuelwood, and 7,050 Christmas trees were harvested from forest lands in the basin. Of the total Wyoming harvest, these amounts are 18 percent of the sawtimber, less than one percent of the poles, and three percent of the posts. No comparative data are available for Christmas trees and fuelwood. There have been recent significant increases in fuelwood harvest. The harvest of other forest products has been increasing at a fairly constant rate. Sawtimber harvest was estimated at 10 million board feet in 1950, 18 million board feet in 1960, and 30.7 million board feet in 1970. The increase is about 1 million board feet each year in the 20 year period (5).

Based upon conversion factors of 4.358 board feet per cubic foot (12-inch log at small end), 90 cubic feet cord for firewood (slightly rough 4-foot lengths), and the 1970 base year, the average annual harvest is about 7,402,100 cubic feet of roundwood. This rate of harvest can be compared to the present annual growth rate of 11,053,900 cubic feet. Within the accuracy of the data, it can be said that the rate of harvest is 67 percent of the growth rate. By the year 2000, total potential roundwood production could be 21,700,000 cubic feet as a result of thinning and other cultural practices and the decline in the mortality.

Water Use and Potential

Present Reservoirs

The perennial headwater streams contribute over 80 percent of their annual flows during the heavy snowmelt period in May, June, and July. Runoff is the greatest in May and June. Many reservoirs store spring runoff to provide irrigation water at some locations such as those listed in Table V-29.



Fontenelle Dam and spillway on the Green River
Soil Conservation Service

Table V-29 Active storage, water source and use of principal reservoirs, (over 900 acre-foot capacity), Green River Basin, Wyoming

Reservoir	Active storage capacity (acre-feet) 1/	Use 2/	Water source or outflow
Flaming Gorge 3/	3,516,000	I, P, F&WL, R	Green River
Fontenelle	190,000	D, I, M&I, F&WL, P	Green River
Lake Viva Naughton	42,390	M&I, P, D	Hams Fork
Big Sandy	38,300	I, F&WL, R	Big Sandy River
Meeks Cabin	29,480	I	Blacks Fork
Boulder Lake	22,280	I, F&WL, D	Boulder Creek
Fremont Lake	20,600	I, S, D	Pine Creek
New Fork Lakes	20,340	I	West Fork of New Fork River
Willow Lake	18,820	I, S, D	Lake Creek
Bush Creek	17,270	I, S, D	Bush Creek (Great Divide Basin)
Eden	11,800	I, D	Big Sandy River and Little Sandy River
Hay	8,330	I, S, D	Red Creek (Great Divide Basin)
Sixty-Seven	5,210	I, S, D	North Piney Creek
Middle Piney	4,200	I, S, D	Middle Piney Creek
Hog Park 4/	3,040		Little Snake River
Bush Lake	1,690	I, S	Bush Creek (Great Divide Basin)
Elkhorn	1,450	I, S	Little Sandy River
Patterson Lake	1,240	I	Blacks Fork River
Black Joe Lake	1,100	I	Black Joe Creek
McNinch	1,090	I, S, D	North Piney Creek
Kemmerer #1	1,060	M&I	Hams Fork
Divide	1,030	I, S, D	Divide Creek
Silver Lake	930	I, S	Silver Creek

1/ Lake storage based on adjudicated rights. May differ from actual usable capacity.

2/ From information on file in State Engineer's Office. I = irrigation, M&I = municipal and industrial, P = power, F&WL = fish and wildlife, R = recreation, S = stock, D = domestic.

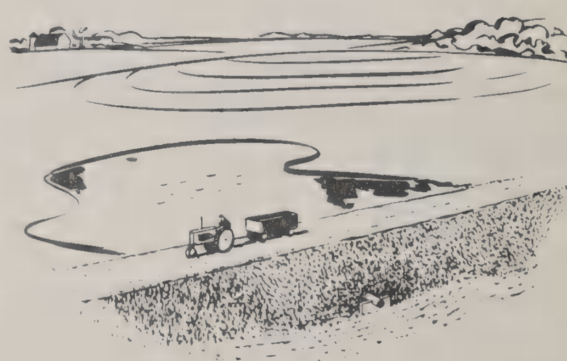
3/ Dam is in Utah, but most of the reservoir is in Wyoming.

4/ Not in Green River Basin, but does store water for the Little Snake River for the Cheyenne diversion.

Present Depletion

An analysis of present (1975) and future committed depletions of Colorado River Compact water by Wyoming is given in the Resource Base Working Paper (8). Depending upon the estimate of Compact water supply, there may be from nearly 400,000 to over 600,000 acre-feet of water per year available in the Green River Basin for future use. In the basin, 250,700 acre-feet of water are consumed annually for irrigation including 1,100 acre-feet diverted annually from Little Sandy River through the Continental Ditch to the Sweetwater River, a drainage of the North Platte River system. Additionally, 6,500 acre-feet are consumed by municipal, domestic, and livestock uses; 35,400 acre-feet by industrial uses; 6,300 acre-feet by recreation, fish, and wildlife uses; and 7,000 acre-feet are diverted out of the basin for the City of Cheyenne's municipal supply. Another 26,300 acre-feet per year evaporates from reservoirs in the basin. Wyoming's share of the Colorado River Storage Project Evaporation (CRSP) is 73,000 acre-feet. The 73,000 acre-feet of CRSP evaporation is not a depletion in Wyoming, but is charged to Wyoming's Compact allocation, and therefore not available for use. Total depletion of Wyoming's Compact water is 332,200 acre-feet. With the addition of the 73,000 CRSP, the depletion of Wyoming's allocation is 405,200 acre-feet (Table V-30).

Industrial uses, including oil well drilling, secondary oil recovery, coal mining operations, and others, use about 4,800 acre-feet of groundwater annually. About 2,100 acres of irrigated land in the basin use groundwater as the principal source of water supply. Irrigation consumptive uses from groundwater are estimated to be 2,000 acre-feet annually.



Potential Reservoirs

Twenty-three watersheds were evaluated for water shortages under present irrigation use and cropping patterns. This effort was not only directed at identifying the existing water shortages, but also at locating potential reservoir sites and their potential for storing irrigation water as well as water for other uses. Numerous storage sites were located, and storage capabilities were evaluated (9). Potential storage sites were also evaluated by the Sublette Study Team of the Bureau of Reclamation and are included in the report prepared for the Sublette Study (22).

The location of the potential storage sites for the Wyoming Range are shown in Figure V-27, and the location for those in the Wind River Range are shown in Figure V-28. All storage sites were given a number

Table V-30 Analysis of Wyoming's water depletions in 1975, Green River Basin, Wyoming 1/

		Acre-feet per year
I. Wyoming depletions of Colorado River water (1975):		
Irrigation (includes 60% of Lyman Project)		250,700
Municipal, domestic, and stock		6,500
Municipal and domestic (43,000 people x 1 ac.ft./5 people x 1/2 depletion)	4,300	
Livestock consumption	2,200	
Industrial		35,400
Coal industries		
Electric power (1213 MW x 15 ac.ft./MW)	18,200	
Carbonizers (2 x 1000 ac.ft. each)	2,000	
Oil and gas (negligible)		
Trona (7.4 million tons x 0.62 x 1000 gal./ton)	14,100	
Natural gas (138 billion cubic feet/year x 8 acre-feet)	1,100	
Reservoir evaporation		26,300
Reservoirs	23,900	
Stock ponds	2,400	
Fish and wildlife, and recreation (Recreation 300 a.ft./year; Seedskadee refuge approximately 30% of total)		6,300
Total in-basin depletion		325,200
Export (Cheyenne diversion)		7,000
Total Wyoming depletion		332,200
CRSP evaporation (14% x 520,000)		73,000
Total depletion of Wyoming allocation		405,200

1/ Source: Wyoming Water Planning and Bureau of Reclamation.

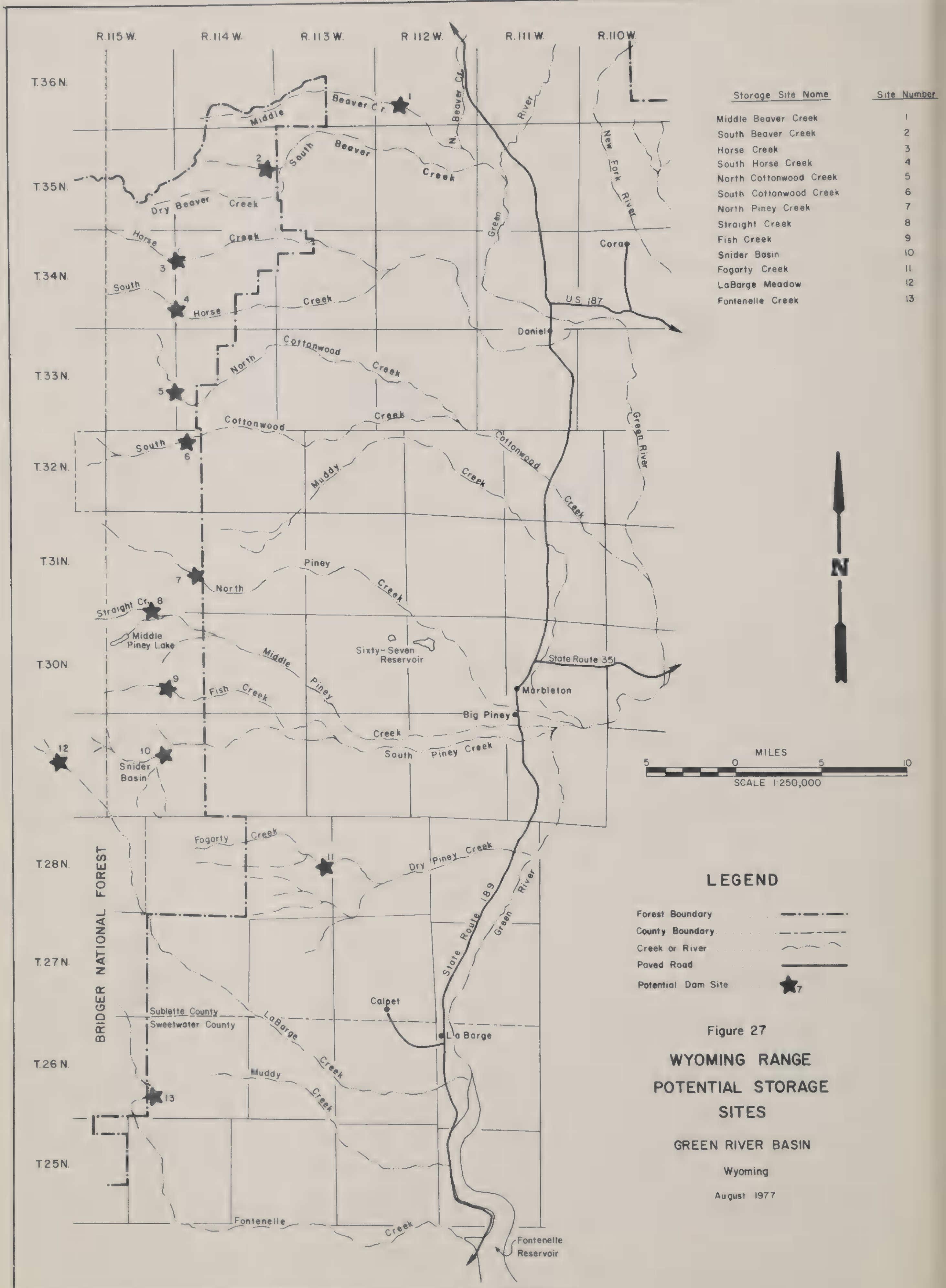


Figure 27

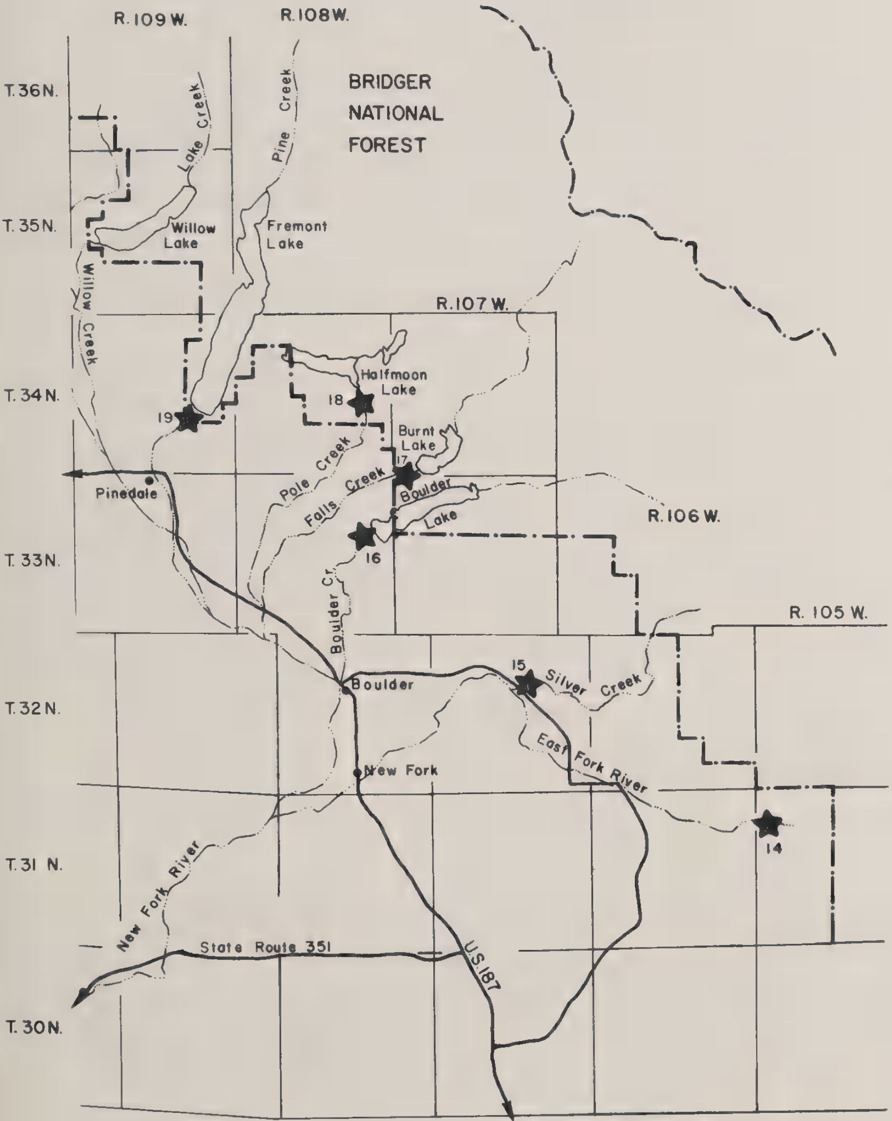
WYOMING RANGE POTENTIAL STORAGE SITES

GREEN RIVER BASIN

Wyoming

August 1977

Storage Site Name	Site Number
East Fork River	14
Silver and Spring Creek	15
Boulder Creek (Boulder Lake)	16
Falls Creek (Burnt Lake)	17
Pole Creek (Half Moon Lake)	18
Pine Creek (Fremont Lake)	19



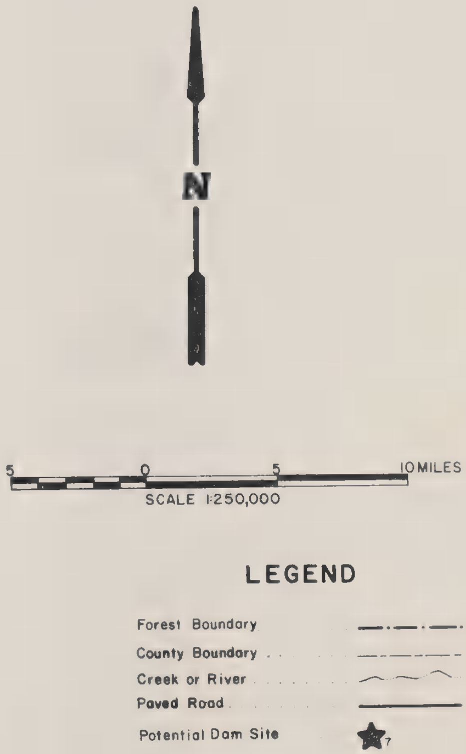


Figure 28
WIND RIVER RANGE
POTENTIAL STORAGE
SITES

GREEN RIVER BASIN

Wyoming

August 1977

for identification purposes and are shown on the figures as well as in Table V-31.

In some watersheds, storage potential was insufficient to supply needed supplies for late season use. At other locations, available potential storage is in excess of that needed locally.

Two evaluations were made of water shortages. One evaluation considers the present irrigation situation with no change in crops or methods of irrigation. This shows a level of water shortages which amounts to 26,880 acre-feet on 58,100 acres, excluding the Eden-Farson, Lyman-Mountain View areas, and the Little Snake River drainage in Wyoming. The second evaluation measures shortages remaining after the installation of potential storage projects.

For the second evaluation, it was assumed that development of water storage projects would necessitate users to obtain near maximum production from their land. Doing so would require more irrigation water than what they are now using. This, then, would result in greater shortages for some irrigated land than what presently exists. With maximum forage production, 15 watersheds would have a water shortage, and six would not. This shortage would amount to 119,700 acre-feet on 130,450 acres.

Of the 15 watersheds with shortages, nine have potential storage sites. In some watersheds storage is more than adequate to meet irrigation water needs for maximum production. In other watersheds, a shortage would still remain after reservoir construction. From the analysis, it generally can be concluded that those irrigated lands needing water most have the least water, and those needing water least have the most water. A major irrigated area where shortage would still exist, even after the installation of potential reservoirs, is the Big Piney area. For maximum crop production, shortages would still amount to 63,260 acre-feet. In contrast, after the construction of potential reservoirs, surplus stored water would exist in the Pinedale area. Total surplus would be 228,020 acre-feet. Table V-32 gives water storage potential and economic analyses by watersheds.

Irrigation Efficiency

Late season irrigation water shortages could be alleviated considerably by a substantial increase in irrigation efficiency. An overall irrigation efficiency of 30 percent at diversion point was used as a basic assumption, except in a few localized areas, where 20 percent was used in determining water shortages.

Water spreading is the common method of irrigation. Water is spread along the top of the fields and runs over the pasture and hayland with little control. From the bottom of the first field the water is picked up and again spread out to where it can flood over the next field. This is a common method of irrigation from field to field, and from ranch to ranch. Irrigation water is frequently allowed to flow on the fields continuously until harvest. This causes over-irrigation of

Table V-31 Irrigation water shortages by watersheds and storage potential for present and maximum production, Green River Basin, Wyoming

Watershed	Presently irrigated acres	Acres of irrigated area with shortage	Seasonal water shortage: Present level of irrigation and agronomic management	Seasonal water shortage: Maximum potential level of irrigation and agronomic mgt.	Storage site Map number	2/ Present condition irrigation storage potential (less sediment)	3/ Future condition irrigation storage potential (less sediment)	Water balance: Present level of production	Water balance: Maximum level of production	Potential irrigable acres using storage in excess of maximum production needs
			------acre-feet--------			------acre-feet--------		------acre-feet--------		--acres----
East Fork	8,260	800	60	6,970	14	29,950	29,400	29,890	22,430	5,140
Muddy Creek (East Fork)	1,185	0	0	230	-	0	230	0	0 1/	0
Silver and Spring Creek	2,174	678	210	1,350	15	16,980	16,600	16,770	15,250	3,500
Boulder Creek	9,909	0	0	0	16	65,090	57,130	65,090	57,130	13,100
Fall Creek (Burnt Lake)	1,848	557	380	700	17	15,570	13,310	15,190	12,610	2,890
Pole Creek (Half Moon Lake)	3,340	0	0	0	18	48,590	47,000	48,590	47,000	10,780
Pine Creek (Fremont Lake)	9,240	0	0	0	19	77,750	73,600	77,750	73,600	16,890
New Fork from the lake to mouth at Willow Creek	14,300	0	0	13,910	-	0	0	0	- 13,910	0
Willow Creek and Lake Creek	4,910	0	0	580	-	0	0	0	- 580	0
New Fork below Pinedale	6,187	0	0	0	-	0	0	0	0	0
New Fork (Paradise Canal)	2,200	735	1,270 4/	1,270	-	0	0	0	0	0
Beaver Creeks (2 storage sites)	8,369	8,287	4,420	12,580	1 & 2	3,490	3,950	- 930	- 8,630	0
Horse Creek (2 storage sites)	15,920	15,251	4,860	11,400	3 & 4	23,790	23,540	18,930	12,150	2,840
Cottonwood Creek (2 storage sites)	20,000	0	0	15,580	5 & 6	6,270	5,570	6,270	- 10,010	0
North Piney Creek	17,034	12,023	2,210	20,960	7	3,380	2,320	1,170	- 18,640	0
Middle and South Piney Creek (3 storage sites)	19,400	16,960	12,460	28,230	8,9,10	2,440	2,250	-10,020	- 25,980	0
Dry Piney Creek	420	336	110	110	11	300	300	190	190	50
LaBarge Creek 5/	7,857	0	0	0	12	6,830	6,450	6,830	6,450	1,450
Fontenelle Creek	3,491	0	0	0	13	10,109	9,920	10,109	9,920	4,930
Hams Fork	11,715	0	0	4,930	-	0	0	0	- 4,930	0
Muddy Creek (Blacks Fork Trib.)	2,716	2,464	900	900	-	0	0	0	- 900	0
Total	xxx	58,091	26,880	119,700		310,539	291,570	xxx	xxx	61,570

1/ Water stored on East Fork site could be used here.
2/ Present crop acreage and crop pattern was used to determine consumptive use and diversion requirements. (Water availability at the site = 80% chance yield - crop requirement)
3/ Max. potential cropping pattern used for consumptive use and diversion requirements.
2/ & 3/ Note: Ac. ft. values are different in future condition because crop need is greater during irrigation season; therefore, less water available for storage.
4/ Ditch loss problem - not lack of water.
5/ The LaBarge site is likely infeasible for water storage. A recent investigation revealed intersecting geologic faults.

Table V-32 Water storage potential and economic analysis by watershed, Green River Basin, Wyoming

Watershed	Map Number	Total storage in acre-feet 1/	Total agricultural storage less sediment acre-feet	Total installation cost (million dollars) 2/	Operation and maintenance cost	Total average annual cost 3/	Average annual cost for portion of water used by agriculture	Av. annual national economic development benefits for agri. 4/	National economic development benefit-cost ratio for agriculture 5/	Average annual cost per acre-foot storage 6/
East Fork 7/	14	46,070	7,205	17.580	12,700	1,179,100	192,300	60,100	0.31 : 1.00	26.75
Silver & Spring Creek	15	17,740	1,348	5.024	7,400	340,700	27,700	31,700	1.14 : 1.00	20.50
Boulder Creek 8/	16	57,130	-	1.785	4,000	122,400	-	-	- -	2.15
Fall Creek (Burnt Lake)	17	13,310	697	2.147	4,700	147,200	7,700	28,600	3.71 : 1.00	11.05
Pole Creek (Half Moon Lake) 8/	18	47,000	-	1.531	2,200	103,800	-	-	- -	2.20
Pine Creek (Fremont Lake) 8/	19	73,600	-	1.961	3,000	133,100	-	-	- -	1.80
Beaver Creek (two sites)	1 & 2	5,905	3,490	3.772	8,600	258,900	172,900	77,600	0.45 : 1.00	49.55
Horse Creek (two sites)	3 & 4	36,660	11,400	18.453	20,000	1,244,400	401,200	293,600	0.73 : 1.00	35.20
Cottonwood Creek (two sites)	5 & 6	10,805	6,270	9.440	14,900	641,200	427,400	67,900	0.16 : 1.00	68.20
North Piney Creek	7	6,320	3,380	3.078	6,000	210,200	140,200	118,400	0.84 : 1.00	41.45
Middle and South Piney Creek	8, 9 & 10	4,815	2,440	2.990	8,000	206,400	137,400	135,200	0.98 : 1.00	56.30
Dry Piney Creek	11	700	112	0.445	1,400	30,900	14,400	3,500	0.24 : 1.00	103.00
LaBarge Creek 8/	12	9,875	-	1.095	2,900	75,600	-	-	- -	7.80
Fontenelle Creek 8/	13	15,950	-	4.748	7,800	322,800	-	-	- -	21.70

1/ Total storage includes (1) active storage; (2) inactive storage; (3) sediment storage.
2/ Total installation cost includes (1) construction; (2) land rights; (3) relocation; (4) water rights; (5) engineering services; (6) project administration.
3/ Total installation cost @ 6 5/8% interest 100-yr. evaluation plus O&M.
4/ These benefits are direct dollar benefits to the user for supplemental water on presently irrigated land.
5/ Benefit cost-ratio for supplemental irrigation water on existing irrigated land.
6/ Average annual cost per acre-foot of active and inactive storage, (sediment excluded). Active and inactive storage required to take proportionate share of sediment storage.
7/ Includes storage water for the Muddy Creek Irrigated Area.
8/ No supplemental irrigation water required for the watershed. No other agriculture uses were evaluated. Also see footnote 5/ Table V-31.

plants and results in inefficient use of water. An increase of irrigation efficiency from 30 to 50 percent would nearly double the water supply and actually reduce the shortages to a minor amount under present cropping patterns. In some area increased efficiency would also reduce salt loading. Table V-33 contrasts the irrigation shortages for the two levels of irrigation efficiencies.

Water Quality

Industrial water uses are largely 100 percent consumptive and have little effect on salinity. Low population density and waste water treatment limit municipal salinity contributions to minor amounts.

Irrigation may contribute significant amounts of salinity, but since few irrigation return flows are monitored in the basin, this contribution is difficult to quantify. A major portion of the Green River salinity is from geologic sources. Notable streams with above average salinity concentrations are Big Sandy River, Blacks Fork River and Henrys Fork.

A water quality sampling program has been underway for many years by the State of Wyoming, the Bureau of Reclamation, and the U.S. Geological Survey. Table V-34 gives the high and low total dissolved solids for selected stations along with the corresponding streamflows and pH readings. For some stations more than two entries are given just to emphasize the variance that occurs.

Other water quality characteristics are not shown, but are available from various publications published by the U.S. Geological Survey, Wyoming Water Resources Research Institute, and Bureau of Reclamation. During the years 1963, 1964 and 1965 the Environmental Protection Agency also did water quality studies on the Green River at several locations (20).

An analysis of the published water quality information shows that the Green River at the town of Green River averages 320 mg/l total dissolved solids. Additionally, levels of dissolved oxygen in the Green River remain nearly constant. Turbidity generally increases downstream, except immediately below Fontenelle Reservoir. Coliform levels are fairly constant downstream, rising abruptly below the effluent discharges from the towns of Green River and Rock Springs.

Sediment damage is negligible except in isolated areas and to Flaming Gorge Reservoir. Irrigation canals and ditches accumulate sediment deposits, and many conveyance systems have to be cleaned annually. Most of the sediment deposited in the irrigation systems comes from the diverted flows. Some sedimentation occurs on hay and pasturelands during high runoff, but damage is usually slight and localized, and generally restoration costs are insignificant.

Suspended sediment loads in streams reduce water quality for irrigation, municipal, domestic, and industrial purposes. Within the

Table V-33 Irrigation water shortages using 30 and 50 percent irrigation efficiencies, present cropping pattern, for selected watersheds, Green River Basin, Wyoming

Watershed	Irrigation area	30 percent efficiencies 1/ Diversion shortage ac.ft.	Water shortage acres	50 percent efficiencies 2/ Diversion shortage ac.ft.	Water shortage acres
East Fork	8,260	60	800	0	0
Silver & Spring Creek	2,174	210	678	0	0
Fall Creek	1,848	380 3/	557	0	0
Paradise Canal	2,200	1,270 4/	735	0	0
Beaver Creek	8,369	4,420	8,287	2,100	7,869
Horse Creek	15,920	4,860	15,251	920	10,000
North Piney Creek	17,034	2,210	12,023	0	0
Middle & South Piney Creeks	19,400	12,460	16,960	360	7,400
Dry Piney Creek	420	110	336	0	0
Muddy Creek	2,716	900 5/	2,464	900	2,464
Totals	78,341	26,880	58,091	4,280	27,773

1/ Present irrigation practice of water spreading.
2/ Present condition cropping pattern. Efficiency increased to 50 percent by all or any of the applicable practices: (1) sprinkler irrigation; (2) border dike; furrow irrigation; consolidation of ditches; lining of ditches; irrigation rotation system; improved diversion structures; installation ditch turnout structures; and land leveling or smoothing.
3/ 20 percent efficiency for present condition.
4/ 15 percent efficiency for present condition.
5/ 50 percent efficiency for present condition.

Table V-34 Maximum and minimum total dissolved solids and pH by date and streamflow for selected stations, Green River Basin, Wyoming 1/

Location	Date	TDS (mg/l)	Flow (cfs)	pH
Green River at Warren Bridge	7-16-70	88	1,020	7.3
	12-3-70	426	80	7.9
New Fork near Big Piney	6-6-70	35	3,640	6.3
	12-7-73	364	146	8.1
Green River below Fontenelle	6-2-69	154	7,720	8.1
	11-2-69	382	302	7.1
Big Sandy below old Diversion Dam	4-6-59	158	65	7.8
	5-1-61	231	N.A.	8.0
	7-16-64	32	180	8.0
Big Sandy two miles below Farson	3-7-61	4,950	4.0	8.1
	4-13-62	442	N.A.	8.3
	5-13-69	322	368	7.9
	7-2-72	237	88	7.7
	10-10-72	2,410	37	8.1
	10-5-74	2,600	52	8.0
Big Sandy 26 miles below Farson	1-16-64	4,910	20	8.0
	6-26-68	603	330	8.0
Green River near Green River, Wyoming	3-11-69	758	322	7.8
	7-10-71	189	5,040	8.1
Bitter Creek near Green River, Wyoming	1-23-72	953	3	7.5
	5-6-69	5,180	5	8.1
Blacks Fork near Milbourne	7-7-64	28	450	8.0
	5-5-67	121	50	8.1
Blacks Fork near Lyman	5-18-72	299	790	7.8
	12-18-59	2,006	50	8.3
	9-14-60	4,912	N.A.	8.0
Blacks Fork near Little America	2-10-70	112	96	8.0
	11-6-73	2,110	318	8.1
	1-22-70	1,790	48	8.3
West Fork of Smiths Creek near Robertson	6-26-64	34	75	7.0
	1-8-64	158	2	8.2
Smiths Fork at Mountain View	5-20-60	152	N.A.	7.9
	11-10-60	472	N.A.	8.4
	9-14-59	375	22	8.4
Henrys Fork near Lonetree	7-13-71	27	66	6.5
	11-22-71	94	10	N.A.
Henrys Fork near Manila, Utah	4-17-72	447	102	8.1
	8-2-72	1,380	2.8	7.8
	9-5-74	1,780	3	N.A.
Hams Fork near Granger	5-11-69	221	912	7.7
	1-17-70	832	4	8.1
Little Snake River at Dixon	10-26-73	41	98	8.0
	8-1-66	1,270	2,640	8.0
	12-15-71	392	128	8.3

1/ Data are not separated here by who took the samples. Agencies involved were U.S. Geological Survey, Wyoming Water Resources Research Institute, and Bureau of Reclamation.

Green River Basin, the towns of Pinedale, Kemmerer, Green River, and Rock Springs divert water from streams and lakes for domestic use. Provisions for filtering or removing sediment are provided in the municipal treatment plants for these towns. Treatment costs increase with increased sediment loads, but the costs have not been quantified.

Reservoir capacities are reduced by the deposit of sediment. Table V-35 presents the estimated average annual sediment load deposited for major reservoirs.

Table V-35 Estimated sediment yields to major reservoirs, Green River, Basin, Wyoming

Reservoir	Drainage area above reservoir	Average annual sediment yield 1/
	Square miles	acre-feet
Fontenelle	4,217	133
Big Sandy	405	53
Flaming Gorge	9,225	2,010
Meeks Cabin	89 2/	3.6

1/ Source: Bureau of Reclamation
2/ In Wyoming only

In recent years, the Southwestern Wyoming Water Quality Planning Association has prepared a report on water quality that covers most of the Green River Basin (14). From their study nitrogen was not considered to be a problem or data were too incomplete for a conclusion. Phosphate levels were listed as unacceptable at several location, but the data are inconclusive.

Recreation Use and Potential

Land and Water Activities

Camping, picnicking, fishing, and hiking, along with boating are favorite recreation pursuits in the basin. Facilities for these activities are located not only on National Forests, but also on state, private, and BLM lands. See Table V-36 for recreation use in these activities.

Table V-36 Recreation participation for selected activities, 1975, Green River Basin, Wyoming

Activity	Unit	Amount	1975 Participation 1/
Boating	Launch sites	11	217,900
Camping	Sites	36	416,700
Trailheads	Number	6	130,040
Hiking trails	Miles	1,069	
Picnicking	Sites	26	669,700
Fishing			
Streams	Miles	2,953	435,100
Lakes	Acres	69,700	401,600

1/ A participation is a recreation activity taking place during any part of a 24-hour period.

Jim Bridger Wilderness Area east of Pinedale
Soil Conservation Service

Excellent potentials exist to provide additional recreation opportunities in camping, picnicking, boating, and lake and reservoir fishing. However, there is limited potential to increase stream fishing. Providing access to streams that are not presently open to the public is a fishing potential that needs to be explored.

From 1970 to 1974, Jim Bridger Wilderness area use increased from 135,450 visitor days to 196,150 visitor days.8/ This is a 31 percent increase or about six percent a year. Hiking, camping, and pack and saddle stock use is concentrated along certain trails, streams, lakes, and campsites. With improved trail access and trailhead facilities, controlled use, better distribution and user education, more visitors could be accommodated. Wilderness capacity has not been fully determined in all locations. Ongoing inventories are being conducted to determine future capacity.

Hunting and Wildlife Harvest

Hunting is a primary recreational use of wildlife resources. However, wildlife is also trapped for fur, provides opportunities for photography, enhances the esthetic experience of other activities, and is a major component of the natural scene that attracts many recreation visitors. The Green River Basin is renowned for high hunter success and opportunities to seek trophy game animals. For purposes of the study, the present hunter use of wildlife resources was considered the capacity. A hunter day is defined the same as a "participation" and consists of all or any part of a day spent in hunting wildlife (Table V-37).

Hunting participations in 1970 were about 108,500. This is the only recreation activity evaluated showing a slight downward trend in participation. Because of the closely regulated nature of this activity, this downward trend may be due to restraints in license sales. Another possibility is that hunting is becoming less popular. However, because of projected resident population increases, an increase in the demand for hunting to 256,000 participations by 2020 is expected. Whether or not this increase is realized will depend on the ability to maintain or increase the wildlife population.

The Wyoming Game and Fish Department in their Stategic Plan for the Comprehensive Management of Wildlife, 1975-1980, project an increase in big game population (10), thus an increase in hunting harvest could result. This potential increase could come about through improved grazing management systems. In contrast, it may be difficult to even maintain present numbers of wildlife populations and the associated hunting due to energy exploration and mining activities, the infringement of recreation homes into winter habitat areas, and the widespread disturbance of wildlife habitat from general recreation use.

8/ Visitor day is participation in an outdoor recreation activity for a 12-hour period.

Table V-37 Recreational hunting statistics, 1970, Green River Basin, Wyoming

Species	Number hunters	Ave. days hunted	Hunter days	Percent non-resident
Antelope	3,667	1.8	6,790	45
Black bear	509	5.8	2,950	--
Bighorn sheep	37	8.3	310	19
Deer	13,460	3.3	44,370	38
Elk	7,950	3.5	28,110	16
Moose	355	2.7	970	25
Ducks	444	4.8	2,120	--
Geese	333	3.0	1,020	--
Chukar	105	2.8	300	--
Hungarian partridge	19	2.4	50	--
Blue grouse	385	4.3	1,660	--
Ruffed grouse	176	3.3	580	--
Sage grouse	4,631	2.3	10,580	--
Mourning doves	223	1.9	440	--
Cottontail rabbits	1,313	6.3	8,260	--
Total	33,607		108,510	

1/ Hunter day: all or any part of a 24-hour period spent hunting wildlife. (considered to be the annual participation capacity)

Source of information: Wyoming Game and Fish Department Management Area Reports.

Potential methods to increase wildlife numbers are:

1. Increase rangeland production through more intensified grazing management and range improvements.

2. Purchase winter habitat areas to preclude any additional encroachment by residential or commercial developments.

3. Restrict recreational activities in critical wildlife habitat areas.

4. Improve policing and enforcement of present policies regarding off-road vehicular use.

CHAPTER VI

FUTURE CONDITIONS WITHOUT PLAN

CHAPTER VI
PROJECTED FUTURE CONDITIONS WITHOUT PLAN

A part of the planning process is the projection of conditions that are likely to exist in the future. These projections are based on past trends, current conditions, and near future conditions for which there is sufficient information to make reasonable projections. This chapter presents projections of conditions that might be expected in the Green River Basin by the years 1980, 2000, and 2020. The first part of the chapter presents expected changes related to socioeconomic conditions. The second part of the chapter presents future expected conditions related to the specific problems and objectives outlined in previous chapters.

There are numerous ongoing governmental programs which have been and are currently being utilized to remedy a variety of problems which exist in the basin. Several ongoing programs are not extensively used because of the lack of matching funds. Overall, conservation activities have accomplished major improvements in the use of soil and water resources. Future conditions related to each study objective were, insofar as possible, projected on the assumption that existing programs of the Agricultural Stabilization and Conservation Service, Soil Conservation Service, and Forest Service will continue to be offered and utilized at the same rate as in the past few years. Those past accomplishments which required specialized or large group efforts or actions were not included in the projections. A summary of projected future conditions is presented in Tables VI-9 and VI-10 at the end of this chapter.

Socioeconomic Conditions

Population, Employment, and Income

Socioeconomic conditions are projected to change rapidly between 1970 and 2000. Population is expected to increase from 28,290 in 1970 to almost 104,000 by 2000 and 128,950 by 2020 (Table VI-1). Employment is projected to increase more rapidly than population because of the expected changes in the population age-education profile. Earnings, measured in real dollars, are expected to increase 18.5 times between 1970 and 2020.

Table VI-1 Projected population, employment, and earnings
Green River Basin, Wyoming

	1970	1980	2000	2020
Population (no.)	28,287	54,836	103,969	128,950
Total employment (no.)	10,668	24,679	46,833	58,086
Total earnings 1/ (Thousands of 1967 dollars)	83,221	247,067	753,221	1,540,600

1/ Income received by persons in return for contributions to current production, such as wages, salaries, and proprietor's income.

The basis for these rapid changes is the mineral resources of the basin--coal, trona, oil shale, crude oil, natural gas, and uranium. Also, because of the availability of coal and water, electrical power production is projected to increase rapidly with the bulk of the electrical energy produced transmitted to other areas of the country. An estimated 30-40 percent of earnings in the basin are derived from the export of goods and services. A more detailed discussion of the projections presented is provided in the Economic Base Working Paper (3).

Development of the mineral resources will provide needed energy supplies as well as generate increased economic activity in the basin and the nation. These developments and associated rapid growth will cause problems in housing, transportation, and municipal facilities and services. Additionally, new and largely unknown stresses will be placed on the air, water, and land resources. The increased population and the tourist demand for outdoor recreation, if it continues to increase at recent rates, will place considerable pressure on the outdoor recreational resources of the basin.

Agricultural Production

Forage

Agricultural production is projected to increase over the time period presented in this report. Cattle numbers, based on past trends, are expected to increase from 162,690 head in 1974 to 244,620 head by 2000. Stock sheep numbers, which have steadily decreased in the past, are projected to decrease from 227,750 head in 1974 to 83,980 head by 2000 (Table VI-2). The projection of past trends in sheep production actually shows zero production by 2000. However, the more optimistic projection was used for two reasons: (1) much of the rangeland in the basin is very suitable for sheep production; and (2) as total U.S. sheep production declines, prices received by ranchers should rise making sheep a more profitable enterprise.

Besides providing forage for sheep and cattle, the range and forest lands in the basin provide a forage and habitat base for a substantial number of wildlife, particularly big game animals. Big game animal numbers were projected to remain constant at current levels to 2020. Another user of rangeland in the basin is wild horses. The wild horse population was estimated to be 6,000 head in 1974 and increasing at a rate of 20 percent per year. If this rate continues, wild horse numbers could increase to over 15,000 head by 1980 and more than 572,000

head by 2000. However, the U.S. Bureau of Land Management is conducting a program to reduce and stabilize wild horse numbers at about 1,200 head. This study assumes that the BLM program will be fully implemented and effective by the year 2000. Projected livestock numbers, big game, and horse numbers are given in Table VI-2 and displayed graphically in Figure VI-1.

Table VI-2 Projected livestock, big game, and horse populations, Green River Basin, Wyoming

Kind of animal	1974	1980	2000	2020
	Numbers			
Cattle	169,318	192,235	244,620	280,680
Sheep	227,750	181,360	83,980	83,980
Elk	7,150	7,150	7,150	7,150
Deer	42,310	42,310	42,310	42,310
Antelope	32,350	32,350	32,350	32,350
Moose	3,640	3,640	3,640	3,640
Horses				
Domestic	8,170	8,170	8,170	8,170
Wild	6,000	8,000	1,200	1,200

Pasture and hayland acres and yields have been modestly increasing over the past 10-20 years. If future livestock and wildlife forage requirements are going to be met from the basin's production of forage, yields from hay and pastureland, and rangeland will have to continue to improve. Improved hay production was projected to increase substantially. Native hay increases modestly, and pasture is projected to remain constant. Rangeland forage production is projected to increase about five to seven percent between 1974 and 2000. Increased rangeland forage production on BLM and railroad lands is projected to be seven to eight percent, slightly higher than the overall average. Detailed projections of acres, yields, and production are given in Appendix I, Tables A-1, A-2, A-3, and A-4.

Future Forage Supply-Demand Balance

Table VI-3 and Figures VI-2 and VI-3 show the projected total forage supply-demand balance in terms of AUMs. The projections indicate a substantial surplus of AUMs in all time frames. However, there could be a seasonal problem that is not obvious from these data. The main concern is approximately seven months of required winter feed; namely, hay and aftermath grazing for cattle. If one assumes that 7/12 of all cattle and domestic horse AUM requirements must be met by hay and aftermath grazing, it would appear there is a substantial shortage of winter feed for cattle and horses. The apparent shortage ranges from 220,000 AUMs currently to 260,000 AUMs by 2000.

Figure VI-1 Projected livestock, horse and wildlife numbers, Green River Basin, Wyoming

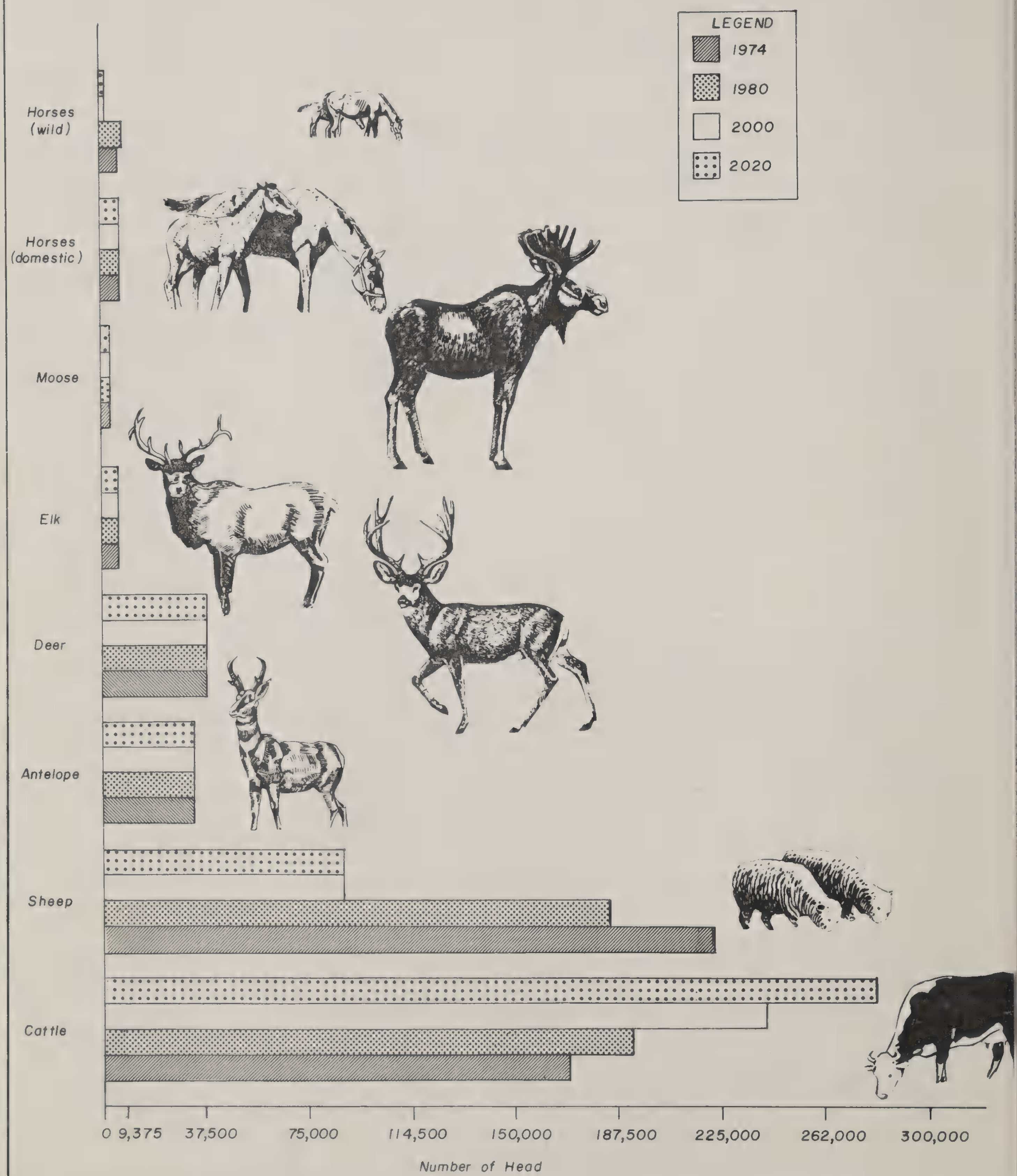


Figure VI-2 Projected forage production by source and by time frames

Green River Basin, Wyoming

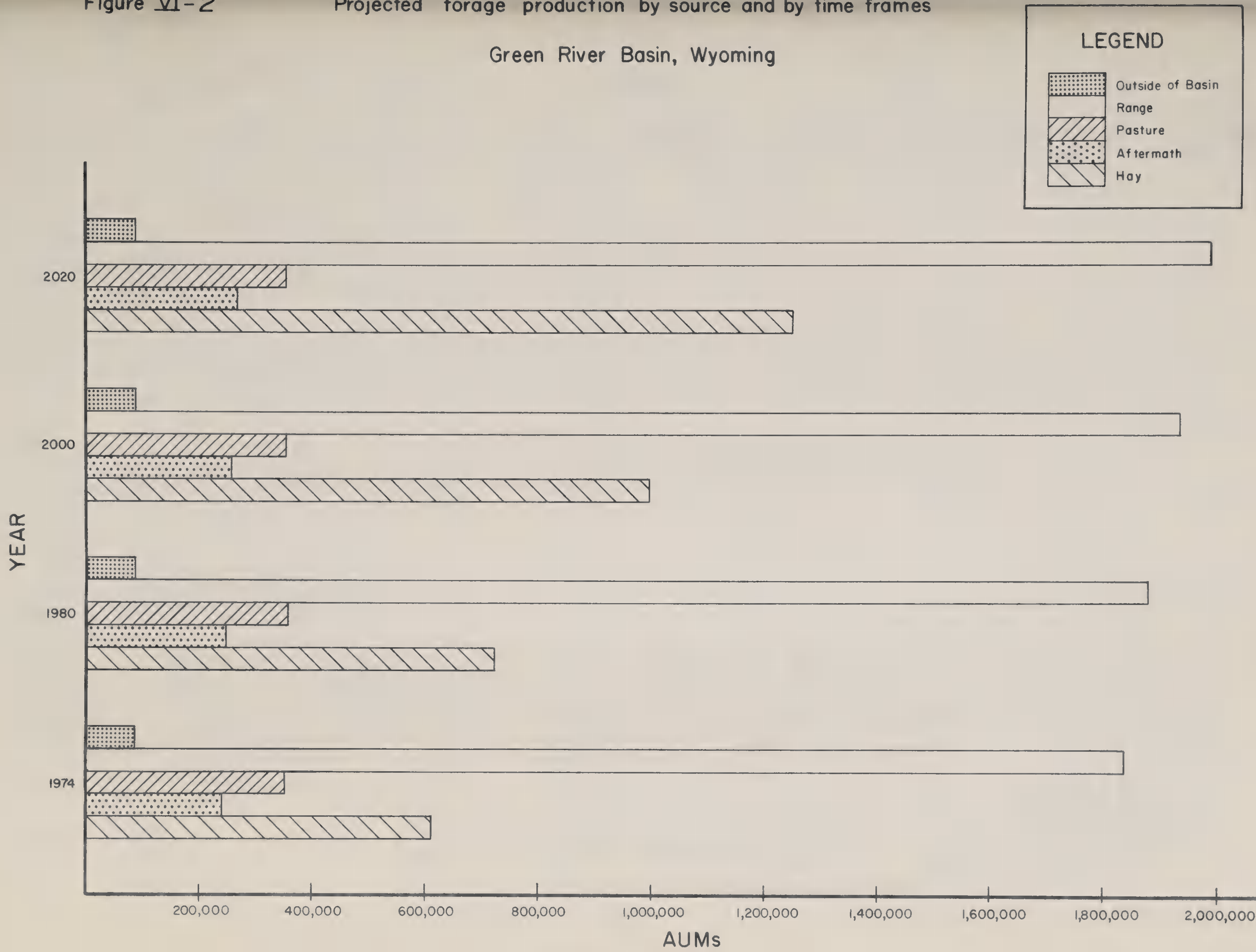


Figure VI - 3 Projected total forage supply and demand

Green River Basin, Wyoming

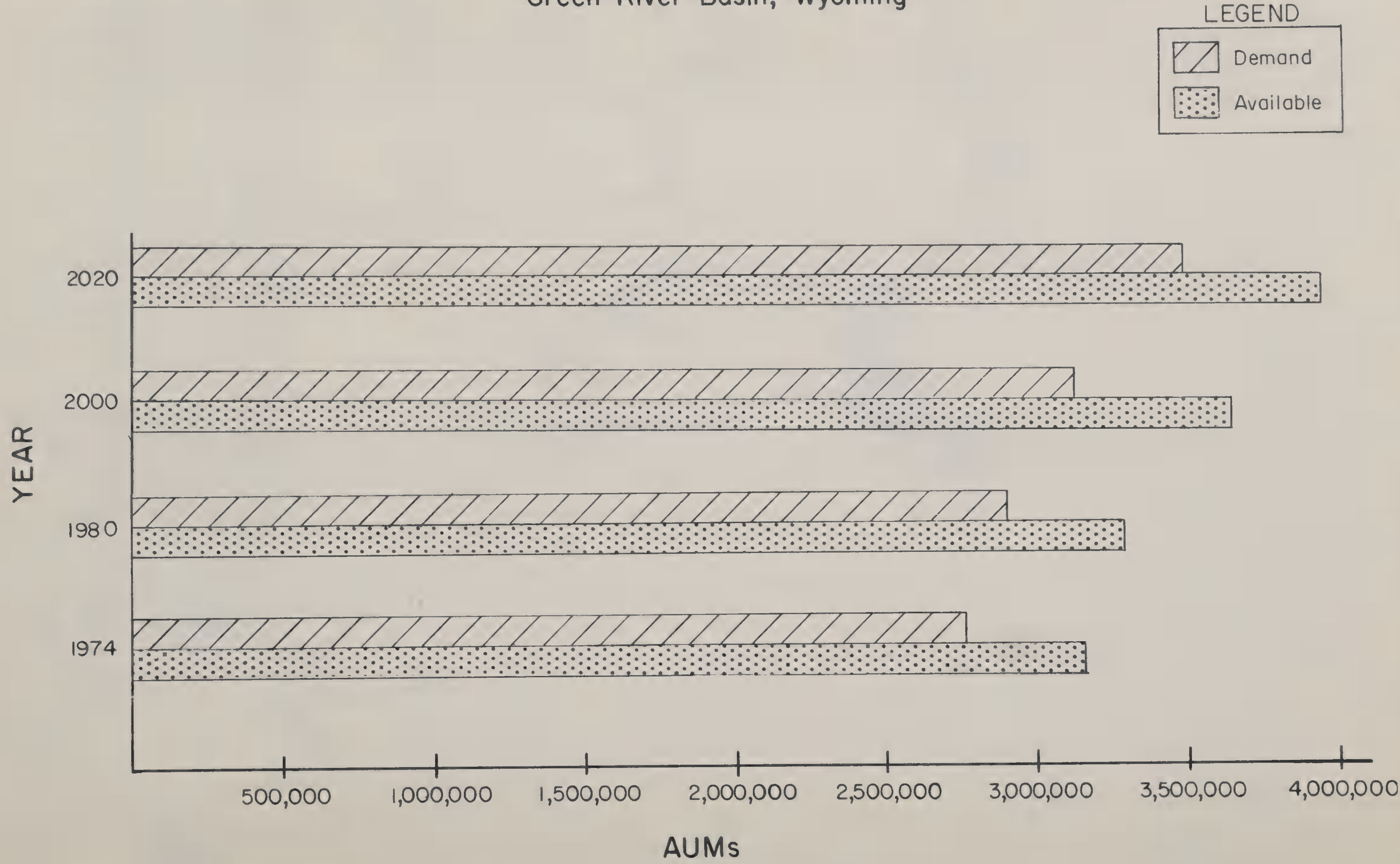


Table VI-3 Projected forage supply-demand, Green River Basin, Wyoming

Crop	Year 1974	1980	2000	2020
AUMs available:	AUMs			
Hay	614,700	724,800	999,095	1,240,955
Aftermath	243,900	246,260	259,680	267,435
Pasture	355,500	355,500	355,500	355,500
Range	1,838,960	1,878,790	1,937,055	1,984,500
Outside of basin	92,200	92,200	92,200	92,200
Total available	3,145,260	3,297,550	3,643,530	3,940,590
AUMs required for:				
Cattle	1,737,200	1,972,330	2,509,800	2,879,780
Sheep	546,600	435,265	201,550	201,550
Horses	212,550	242,550	149,550	149,550
Wildlife	267,000 1/	267,000	267,000	267,000
Total required	2,763,350	2,917,145	3,127,900	3,497,880
AUM BALANCE	+ 381,910	+ 380,405	+ 515,630	+ 442,710

1/ No more than half of this amount will be competitive for the AUMs shown above. There are 749,500 acres of forest lands not included in the AUMs available because livestock are not permitted. Also, forest grazing units consider wildlife needs before livestock permits are issued.

This deficit, however, is not as severe as the data indicate. There are other factors that need to be considered. First, much of the rangeland in the basin is open most, if not all, of the winter. Where adequate stock water exists, many cattle and horses can be and are grazed on range during the winter. Second, there are an estimated 177,650 acres of highly productive rangeland meadow which could be reserved for fall-winter forage if needed. Third, irrigated pasturelands, if managed and rotated properly, could easily provide 120,000 AUMs of fall-winter forage. Fourth, most, if not all, ranchers feed some supplemental concentrates during the winter months in order to provide adequate nutrition for their herds. When all of these factors are considered, along with the hay and aftermath base, there is no shortage of winter feed for the basin as a whole. However, the northern part of the basin (Planning Area I) could effectively utilize an additional 100,000 AUMs of hay by the year 2000 because of increased cattle production and for elk winter feed.

If the conversion from sheep to cattle production in Planning Area II develops to a more significant degree than is projected in this study, then additional hay will also be required in this area. The most feasible method for obtaining the needed hay in Planning Area II would be

to purchase it from other areas of the basin or lease hayland elsewhere in the basin. The other alternative, developing land and pumping water from the Green River, would be too costly and thus economically infeasible.

Forestry

There are 1,739,890 acres of forested land in the basin. Thirty-one percent (542,390 acres) of this total is classified as commercial forest land. Another 104,460 acres are classified as productive noncommercial. These are lands which could provide commercial production but have been removed from commercial use because of legal or administrative decisions.

Generally, forest lands in the basin are relatively low in productivity based on the National Standard Site Classification system. Reasons for low productivity include climate, overmature stands, disease and insect damage and lack of forest management practices. Current net growth on commercial forest land is estimated to be 11,053,900 cubic feet annually. As overmature stands are harvested and replaced by healthier and younger trees and stocking control, net production of wood fiber should increase significantly. In this report net production is projected to increase to 17.8 million cubic feet annually by 2000.

Current roundwood harvest in the basin is estimated to be 7.4 million cubic feet. Total roundwood harvest will decrease in the future due to a projected decline in sawtimber production. This projection is based upon: (a) additional lands set aside for uses other than timber harvest; (b) environmental constraints; and (c) presently unavailable timber harvest technology. Wood fiber yields per acre will likely increase. Pole, post and chip harvest should increase during the next 25 years. Table VI-4 shows projected harvest for various forest products.

Fuelwood is largely harvested from disease and insect killed trees and logging slash. The 1970 harvest of 1,970 cords will increase through 1985 due to a 36 percent increase in demand. Thereafter, a decrease to the year 2000 is expected because the most accessible stands will be converted to younger age classes and contribute less dead wood for fuelwood gatherers.

The clearcutting of lodgepole pine that occurred through the 1960's should provide some increase in Christmas tree numbers by 1985. By 1985, Christmas tree numbers should be adequate to meet a 50 percent increase in demand. After 1985, it is estimated the effects of fire protection and partial cutting will reduce Christmas tree production to 1970 levels. This estimate is based upon the requirement that lodgepole pine Christmas trees must be of premium grade to be sold.

Table VI-4 Projected annual harvest of forest products and annual reforestation and timber stand improvement needs, 1970, 1985, 2000, Green River Basin, Wyoming

Forest products Harvested and treatment	Unit	--- No market for chips --- 1970	1985	2000	With chip market (2000) 1/
Sawtimber	MBM	30,670	16,909	12,000	(12,000)
Poles	Ea	48,600	58,000	66,100	0
Posts	Ea	9,220	10,500	12,500	0
Fuelwood	Cord	1,970	2,679	1,200	0
Chips	Ton	0	8,450	6,000	(10,000)
Roundwood, all convertible products, except Christmas trees	M.Cu.Ft.	7,402	4,290	3,056	0
Annual Reforestation & T.S.I. Needs					
Planting	Acre	3,000	1,000	500	(500)
Site preparation	Acre	3,000	1,000	500	(500)
Thinning (precommercial)	Acre	500	5,000	1,000	(500)
Pruning	Acre	0	0	0	0

1/ Same as 2000 column with adjustments

Projected Future Condition for Specific Study Objectives

Improve Irrigation Water Supplies for Late Season Use

The shortage of late season irrigation water over the entire basin is currently estimated to be 27,400 acre-feet affecting 60,700 acres of land. Most of this shortage (58,100 acres) is located in Planning Area I and is expected to continue unless special efforts are implemented to correct it.

For this report, it was presumed that the Bureau of Reclamation's Savery-Pothook Project would be completed on the Little Snake River in the next decade although funding is not currently available. This project would supply supplemental water to 10,690 acres which includes 2,600 acres presently identified as having a water shortage problem (Table V-24). Full service to another 6,590 acres, all in Wyoming. Essentially, there would not be an irrigation water shortage for the Little Snake River lands in Wyoming upon the completion of the project. With the completion of the Bureau of Reclamation projects in the Lyman-Mountain View area (Planning Area III), there should be only minor water

shortages, and the years when shortages occur should be infrequent. Hence, an evaluation of the irrigation water supplies was not made for Planning Area III during the course of this study. Additionally, with the enlargement of Viva Naughton Reservoir by Utah Power and Light, irrigation water supplies for Hams Fork would be enhanced, although a water shortage was not identified here under present conditions.

It is not expected that any of the late season irrigation water required for the 58,100 acres in Planning Area I will be provided by current ongoing programs. Implementation to reduce this shortage will require project action and accelerated land treatment programs.

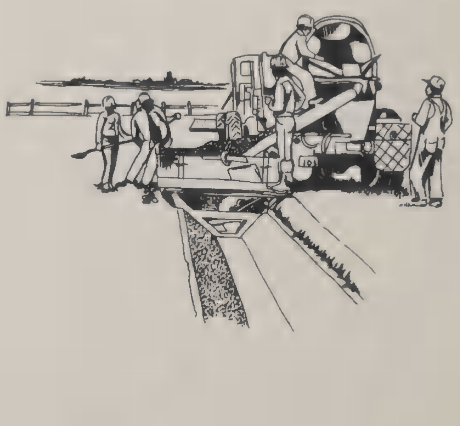
Reduce Salt Loading From the Big Sandy and Blacks Fork Rivers and Henrys Fork

Cooperative studies are underway by several agencies (Bureau of Reclamation, Soil Conservation Service, Agricultural Research Service, Environmental Protection Agency, Forest Service, Bureau of Land Management, and others), under the Colorado River Basin Salinity Control Act, to locate high salt contributing tributaries to the Colorado River system, determine amounts of salt loading, and identify causes as well as ways to reduce the problem. Tributaries identified in the Green River Basin are Big Sandy River, Blacks Fork River and Henrys Fork. The salt loading problem in the Big Sandy River Watershed is currently being studied. If a feasible solution is discovered and funding made available, an implementation program is expected to be underway within the next ten years.

Although the Blacks Fork River and Henrys Fork have been identified as contributors of salinity to the Colorado River system, investigative studies have not been initiated. A tentative schedule has been programmed by USDA to analyze these two drainage areas as a part of the Colorado River Salinity Control Studies.

Improve Irrigation Water Use Efficiency

There are 205,000 acres within the 336,100 acres of irrigated land in the basin with soils that would respond to land treatment measures necessary to improve irrigation efficiency. About 40,500 acres of the 205,000 acres have already been improved. Under current programs and rate of land treatment application on irrigated land, 48,000 acres will be efficiently irrigated by 1980, 88,000 acres by 2000, and 128,000 acres by 2020.



Utilization of Fuelwood and Small Wood Products

Harvest of dead wood for fuel will increase due to several social and economic factors. Basin residents and populations in northern Utah and southwestern Wyoming are experiencing higher utility costs. Many persons are installing or using wood burning stoves and fireplaces. Regardless of future programs, demand for fuelwood will greatly increase. In the basin, forest land products demand will eventually exceed availability. Thus, fuelwood harvest is projected to increase in the near future, then decrease by the year 2000.

Post and pole harvest by primarily basin residents will probably increase modestly. Significantly more small wood products are available for harvest than are being harvested. The projected future harvest is given in Table VI-5.

Table VI-5 Projected fuelwood, post, and pole harvest, Green River Basin, Wyoming

Product	Time Frames		
	1980	2000	2020
Fuelwood (cords)	2,440	1,200	1,200
Poles (each)	54,370	66,100	66,100
Posts (each)	10,070	12,500	12,500

Roundwood Production and Harvest

Roundwood production is expected to increase from 11.1 MMcu.ft. in 1970 to 12.5 MMcu.ft. in 1980, to 16.6 MMcu.ft. in 2000; and to 17.8 MMcu.ft. in 2020. These increases are based largely on tree mortality. Total roundwood harvest in the basin is projected to decrease in the future under current ongoing programs. Harvest is expected to decline from 7.4 MMcu.ft. in 1970 to less than 3.0 MMcu.ft. by 2000. Almost all of this decline will result from reduced sawtimber harvest because of constraints previously discussed.

Reduce Erosion on Rangeland

Based on past trends on rangeland improvement, about 225,000 acres more of rangeland will be treated by 1980. This improvement will bring the total area of rangeland in the basin with an erosion rate of less than 0.5 tons/acre/year to 8,747,000 acres. The acres treated by 2000 and 2020 are estimated to be 226,700 and 452,700 respectively, bringing the total acres below the 0.5 ton rate to 8,973,700 and 9,199,700 acres for those years, respectively.

Improve Management and Maintenance of Recreation Facilities

In recent years, funds and manpower expended for recreation facility operation and maintenance have generally been insufficient although light maintenance consisting of garbage collections, roadside cleanup, and minor repair are mostly satisfactory. Notable exceptions to satisfactory light maintenance occur on peak use weekends and holidays in lake and reservoir shore campgrounds.

Adequate funds are usually not available for heavy repair and rehabilitation jobs at older recreation sites. For example, improved water, sewage and garbage systems are often lacking. Tables, signs and traffic barriers are in disrepair. Also, self-contained recreation vehicle drivers find few sanitary dumping stations at the larger recreation complexes. The estimated dollars available for operation and maintenance of developed sites in 1975 was $328,400 which was considered to be 50 percent of the total required.

Supply of Recreation Facilities

Recreation opportunities in the basin are numerous, and participation has been increasing rapidly. Camping is used here as being indicative of the increase in all recreation activities. The annual participation rate for this activity in 1970 was 339,880 people, and the rate for 1975 was 418,000. This is a 23 percent increase. It appears that trends for participation in all recreation activities in the future will be similar if facilities are available.

The miles of streams accessible for fishing in 1975 were 2,391. No increase in the availability of miles of streams for fishing is projected in the future with present programs. Therefore, stream fishing quality, where access is available, can be expected to deteriorate.

The supply of developed recreation facilities has been increasing. However, supply has not increased as rapidly as demand and is expected to lag in the future. Table VI-6 presents the projected number of sites, participation at one time capacity and annual participation capacity for boat launching sites, picnic sites, and camping for the future given current programs.

Utilize Available Colorado River Compact Water

Wyoming is not currently fully utilizing its share of Colorado River Compact water. Present depletions are estimated to be 405,200 acre-feet (Table V-30), leaving 399,800 acre-feet available for use. Estimated future depletions are shown in Tables VI-7 and VI-8. Based on the assumptions and projections shown in these tables, unused water will still be available in the years 2000 and 2020. This will amount to 233,700 acre-feet in 2000, and 188,200 acre-feet in 2020 (Table VI-8).

Table VI-6 Projected number of sites and capacities for three major recreation activities, Green River Basin, Wyoming

YEARS	Boat launching sites			Picnic sites (3 units ea.)			Camping sites (25 units ea.)		
	Number of sites	PAOT 1/	APC 1/	Number of sites	PAOT	APC	Number of sites	PAOT	APC
1980	11	880	155,000	29	431	141,210	40	4,960	376,960
2000	15	1,200	213,000	35	525	179,540	48	5,950	452,200
2020	20	1,600	284,000	43	640	209,410	56	6,940	527,440

1/ PAOT (People at one time) This term is used to determine the theoretical capacities of facilities or resources. It is the numerical capacity based upon a hypothethical number of people that will fully occupy a facility, example: five people is the PAOT capacity of a campground unit; a campground with ten units would have a PAOT of 50.

2/ APC (Annual participation capacity) Represents the capacity of a facility or resource expressed in terms of the "participation rate" that can be accommodated without deterioration of the recreation site and with allowance for peak days in the season.

Table VI-7 Analysis of Wyoming's future and present water depletions, Green River Basin, Wyoming

Committed future depletions		Acre-feet
Lyman Project (40% remainder of project)		4,000
Seedskadee Project		65,000
Wildlife refuge (approximately 70% of total)	14,000	
Irrigation (34,000 ac. x 1.5 ac.ft./ac./yr.)	51,000 (1)	
Savery-Pothook Project		12,000
Cheyenne Diversion Increase		24,000
Fontenelle M&I (2)		185,000
1962 State of Wyoming Contract	60,000	
1974 State of Wyoming Contract	125,000	
Total		290,000
(Total without (1) and (2))		54,000
Total present and committed depletions (405,200 + 290,000)		695,200
(Total present and committed without (1) and (2))		459,200

Water available for new depletions

Depletion status	Water supply assumption 1/ (acre-feet per year)			
	I-A	I-B	II-A	II-A with relief from Mexican treaty
Available to Wyoming 2/	1,043,000	875,000	805,000	910,000
Present depletions 2/	405,200	405,200	405,200	405,200
Remainder available	637,800	469,800	399,800	504,800
Committed depletions above, without (1) and (2)	54,000	54,000	54,000	54,000
Remainder available	583,800	415,800	345,800	450,800

1/ See Table V-6
2/ See Table V-30

Another analysis of remaining water available based on projected industrial, irrigation, and wildlife depletions is shown by time frame in Table VI-8.

Table VI-8 Water available after present and estimated future depletions, Green River Basin, Wyoming

	Years		
	1980	2000	2020
Water available (from Table VI-7 assumption II-A)	399,800	399,800	399,800
Future depletions	---	---	---
Lyman Project	4,000	4,000	4,000
Industrial & municipal	45,900	136,100	181,600
Savery-Pothook Project	---	12,000	12,000
Wildlife refuge	---	14,000	14,000
Remainder available	349,900	233,700	188,200

Increase Production of Winter Livestock Forage

As discussed earlier in this chapter, total forage production is projected to be adequate to supply total projected demand through the year 2020. But, because of the shift from sheep to cattle production, winter feed supplies relative to demand are expected to become tighter. Measured in terms of hay and aftermath production only, winter feed supplies are projected to increase from 858,600 AUMs in 1974 to 1,258,780 AUMs in 2000 and 1,508,390 AUMs in 2020. However, range forage, irrigated pasture and supplemental concentrates also provide some fall-winter feed. These sources, depending on the severity of the winter and summer grazing practices, would supply 150,000 to 250,000 additional AUMs. Although basin-wide winter forage supplies are projected to be adequate Planning Area I could effectively utilize an additional 80,000 to 100,000 AUMs of winter forage by 2000.

Winter livestock feeding near Pinedale
Soil Conservation Service

Protect and Enhance Scenic Stream Corridors

There are 3,568 miles of stream corridors in the Green River Basin classified as scenic stream corridors. Presently, 1,213 miles of stream corridors in visual classes 3-5 are in public ownership, and as such are under some degree of management and protection. It is not expected that any further stream miles in these three classifications will come under public ownership in the near future.

There are 1,556 miles of streams in visual classes 1 and 2 under public ownership. Some of the class 1 and 2 mileage is expected to be treated and enhanced in the future -- 1980, 92 miles; 2000, 405 miles; 2020, 716 miles.

Reduce Concentrated Use Within the Wilderness Area

The Jim Bridger Wilderness area is one of the most popular recreation areas in the basin. In some of the wilderness management units use has become so concentrated that deterioration from erosion, littering

and vegetative degradation has become a serious problem. Given the increased use that is projected, and given the current level of manpower and funding, these problems are projected to become even more severe. Nine of the eleven wilderness management units are particularly in need of better control and management. It is expected that limited improvements will be accomplished with ongoing programs.

Identify and Protect Significant Archeological and Fossil Sites

The Green River Basin contains a wealth of archeological resources. About 800 sites on an estimated 80,000 acres have been recorded. Many more sites need to be investigated and efforts made to protect the more significant sites. Given past efforts, funding and manpower, it is projected that the number of well-documented sites and the level of protection will not change substantially under current efforts.

The basin is estimated to contain about 9,430,000 acres of potential fossil bearing areas. The more adequately described and investigated fossil rich areas extend over an estimated 2,009,000 acres. Based on past trends, it is projected that about 3 million acres will have been adequately investigated by 2000. However, efforts to protect the more significant sites will not be realized under on-going programs.

Preserve and Protect Historical Sites

There have been 127 significant historical sites identified in the basin and 14 have been placed on the National Register. Considerable effort has been made to preserve and protect historical sites. Given the increases in vandalism, energy exploration and increasing costs of preservation and protection, it is doubtful that past trends in funding will be sufficient to meet all the needs. Those historical sites on the National Register will probably receive priority and adequate funding to make improvements and provide adequate protection. The other 113 sites, however, will probably not hold their current condition with present activity and funding.

Reduce Streambank Erosion

Serious streambank erosion exists on an estimated 200 miles of streams in the basin. Some improvement will occur indirectly as rangeland adjoining these streams is treated and improved. However, direct improvement in terms of bank stabilization, revegetation, etc., probably will not occur without an accelerated program.

Provide Minimum Streamflows for Viable Fisheries

Seasonal low flows, which have the potential for decreasing fishery productivity, have been identified for 188 miles of streams and rivers. There is little opportunity under existing programs for improvement in these particular fisheries.

Maintain Fishing Stream Quality

One thousand four hundred sixty miles of streams in the basin have been classified as blue ribbon, very important, and important trout

fishing streams. With increased fishing and continued pressure on stream habitat from other types of activity, maintenance of quality fisheries under existing programs will not be possible.

Enhance and Create Waterfowl Habitat

The Green River Basin contains an estimated 3,940,000 acres of waterfowl habitat consisting of various qualities, but waterfowl breeding areas are limited in number and acreage. The supply of high quality habitat is declining as irrigation efficiency increases and as encroachment occurs. There is potential for creating 10,000-15,000 acres of waterfowl breeding areas and for enhancing habitat on another 19,000 acres. Under current programs, waterfowl habitat quality will probably continue to decline.

Enhance and Protect Critical Winter Habitat for Selected Big Game Species

The Green River Basin contains a total of 4,086,000 acres of critical winter habitat for mule deer, elk, antelope, and moose. About 75 percent of this habitat is estimated to be adequately treated and generally producing forage up to its potential. Ongoing programs by various government agencies are not expected to significantly increase the acreage of adequately treated critical habitat. Continued livestock competition, population growth, and new mineral developments will probably offset ongoing program effects.

Trophy mule deer on winter range
Wyoming Game and Fish Commission

Table VI-9 Amount of specific study objectives within the national economic objective that will be satisfied with ongoing programs by 1980 and 2000, Green River Basin, Wyoming

Specific study objective	Units	Year 1980	Year 2000 1/
1. Improve irrigation water supplies for late season use.	Acres	2,600	2,600
2. Reduce salt loading of the Green River in Big Sandy and Blacks Fork Rivers and Henrys Fork.	Watersheds	0	0
3. Improve irrigation efficiency.	Acres (thousands)	48	88
4. Increase annual utilization of fuelwood and small wood products.	Fuelwood (cords)	2,440	1,200 2/
	Poles (each)	64,870	66,100
	Posts (each)	10,070	12,500
5. Increase annual wood fiber: Production	MM cubic feet roundwood (Production)	12.5 3/	16.6 2/
Harvest	MM cubic feet roundwood (Harvest)	5.3 3/	3.0 2/
6. Reduce erosion on rangeland.	Acres with erosion rate below 0.5 tons/ac./yr. (thousands)	8,747	8,973
7. Improve management of the present recreation activity opportunities and recreation facility maintenance.	Dollars (thousands annually)	937.4	1,558.6
8. Increase recreation facilities.	a. Boat launching sites (no.)	11	15
	b. Picnic grounds (no.) (3 units each)	29	35
	c. Camping grounds (no.) (25 units each)	40	48
	d. Fishing-miles of stream with access	2,391	2,391
9. Utilize available Colorado River Compact Water.	Acre-feet utilized (annually)	455,100	571,300
10. Increase production of winter livestock forage.	AUMs (annually)	262,460	550,000

1/ These quantities include previous time frame amounts.

2/ Year 2000 production is less than 1980 rate.

3/ Number interpolated from 1985 data in Table VI-4.

Table VI-10 Amount of specific study objective within the environmental quality objective that will be satisfied with ongoing programs by 1980 and 2000, Green River Basin, Wyoming

Specific study objective	Units	Year	
		1980	2000 1/
1. Protect and enhance scenic stream corridors.	Miles of stream corridors protected	1,386	1,618
2. Reduce concentrated use in local areas within wilderness management units.	Number of properly managed wilderness management units	2	2
3. Identify and protect significant archeologic and fossil areas.	Acres reconned		
	Archeological	80,000	80,000
	Fossil	2,009,000	3,000,000
4. Preserve historical sites.	Sites adequately protected	14	14
5. Reduce erosion on rangeland.	Acres with erosion rate below 0.5 ton/ac./yr. (thousands)	8,747	8,973
6. Reduce streambank erosion.	Miles of excessive eroding streambanks treated	0	0
7. Provide minimum flows for a viable fishery on certain streams.	Miles of fishery stream corrected of water flow problems	0	0
8. Maintain fishing stream quality.	Miles of stream	0	0
9. Enhance and create waterfowl habitat.	Acres enhanced	0	0
	Acres created	0	0
10. Enhance and protect critical winter habitat for four resident wildlife species.	a. Antelope (acres)	1,126,500	1,260,300
	b. Mule deer (acres)	384,000	520,000
	c. Elk (acres)	547,700	594,700
	d. Moose (acres)	234,900	254,500
11. Utilize available Colorado River Compact Water.	Acre-feet utilized (annually)	455,100	571,300

1/ These quantities include previous time frame amounts.

CHAPTER VII

NEEDS

CHAPTER VII

NEEDS

The purpose of this chapter is to identify needs that will require specific planning efforts to correct or ameliorate problems presented in Chapter III. In this report, a need is defined as the difference between the "desired future goals" presented in Chapter IV and the "projected future without plan" presented in Chapter VI. In other words, if current and projected governmental programs and private efforts are adequate to fulfill the desires presented in Chapter IV, then a need is not identified. If, however, current and ongoing programs are projected to be inadequate to meet the level of desired goals for a given study objective, then a need is identified.

Table VII-1 and VII-2 at the end of this chapter show the level of needs required, by time frame, to fulfill each of the specific study objectives. Table VII-1 shows needs related to the National Economic Objective and Table VII-2 shows needs related to the Environmental Quality Objective. The reason for this division is to meet the requirements specified in the USDA Procedures for Planning Water and Related Land Resources, (26, 28). These procedures specify that planning alternatives be formulated around two broad objectives, National Economic Development (NED) and Environmental Quality (EQ).

Table VII-1 National economic development objective needs by time frame, Green River Basin, Wyoming

Specific study objectives	Units	Total desired goal	1980			2000 1/			2020 1/		
			Desired goal	Projected future without plan	Needs	Desired goal	Projected future without plan	Needs	Desired goal	Projected future without plan	Needs
1. Improved irrigation water supplies for late season use.	Acres	60,700	60,700	2,600 6/	58,100	60,700	2,600	58,100	60,700	2,600	58,100
2. Reduce salt loading of the Green River from the Big Sandy and Blacks Fork Rivers and Henrys Fork.	Watersheds	3	0	0	3	3	0	3	3	0	3
3. Improved irrigation water use efficiency.	Acres	205,200 2/	60,500	48,000	12,500	140,500	88,000	52,500	205,200	128,000	77,200
4. Increase annual utilization of fuelwood and small wood products.	Cords (Ea.)	3,370	2,780	2,440	340	3,370	1,200	2,170	3,370	1,200	2,170
	Posts (Ea.)	14,150	11,840	10,070	1,770	14,150	12,500	1,650	14,150	12,500	1,650
	Poles (Ea.)	74,450	72,160	64,870	7,290	74,450	66,100	8,350	74,450	66,100	8,350
5. Increase annual roundwood: production	MM.cu.ft.	21.7	14.6	12.5	2.1	21.7	16.6	5.1	21.7	17.8	3.9
harvest 3/	MM.cu.ft.	21.7	14.6	5.3	9.3	21.7	3.0	18.7	21.7	3.0	18.7
6. Reduce erosion on rangeland to a rate below 0.5 tons/ac./yr.	Acres (thousands)	11,685.8	9.000.0	8,747.0	252.3	10,000.0	8,973.7	1,026.3	11,685.8	9,199.7	2,486.1
7. Improve management of the present recreation activity opportunities and recreation facility maintenance.	Dollars (thousands annually)	2,982.4	1,548.6	937.4	611.2	2,200.7	1,558.6	642.1	2,982.4	2,378.9	603.5
8. Increase recreation facilities.											
Boat launching	Sites (no.)	36	12	11	1	23	15	8	36	20	16
Picnic grounds	Sites (no.)	147	47	29	18	114	35	79	147	43	104
Campgrounds	Sites (no.)	71	42	40	2	55	48	7	71	56	15
Fishing-miles of stream with access	Stream miles	2,953 4/	2,441	2,391	50	2,953	2,391	562	2,953	2,391	562
9. Utilize available Colorado River Compact water.	Acre-feet (annually)	805,000 5/	805,000	455,100	349,900	805,000	571,300	233,700	805,000	616,800	188,200
10. Increase production of winter livestock forage.	AUMs (annually)	749,790	262,460	262,460	0	650,175	550,175	100,000	749,790	649,790	100,000

1/ Quantities indicated include previous time frame amounts.
2/ Represents total acres on which it is feasible to improve efficiency.
3/ Pole and fuelwood quantities are included.
4/ Represents total fishing stream miles in basin.
5/ Represents minimum water available to Wyoming under the Colorado River Compact as estimated by the Department of Interior. Available for new uses: 188,200 acre-feet after accounting for projected commitments through 2020.
6/ Assumed satisfied by Savery-Pothook Project.

Table VII-2 Environmental quality objective needs by time frame, Green River Basin, Wyoming

Specific study objectives	Units	Total desired goal	1980 Desired goal	1980 Projected future without plan	1980 Needs	2000 1/ Desired goal	2000 1/ Projected future without plan	2000 1/ Needs	2020 1/ Desired goal	2020 1/ Projected future without plan	2020 1/ Needs
1. Protect and enhance scenic stream corridors.	Protected miles of stream corridor	3,178	1,426	1,386	120	2,788	1,618	1,170	3,178	1,929	1,249
2. Reduce concentrated use in local areas within wilderness management units.	Management units properly managed	11	11	2	9	11	2	9	11	2	9
3. Identify and protect significant archeological and fossil areas.											
Archeological	Acres reconned	424,000	80,000	80,000	0	424,000	80,000	344,000	424,000	80,000	344,000
Fossil	Acres reconned	9,430,000	2,209,000	2,009,000	200,000	6,578,500	3,000,000	3,578,500	9,430,000	3,000,000	6,430,000
4. Preserve and protect historical sites.	Sites adequately protected	127	50	14	36	127	14	113	127	14	113
5. Reduce erosion on rangeland to a rate below 0.5 tons/ac./yr.	Acres	11,685,800	9,000,000	8,747,000	252,300	10,000,000	8,973,700	1,026,300	11,685,800	9,199,700	2,486,100
6. Reduce streambank erosion.	Stream miles	200	19	0	19	200	0	200	200	0	200
7. Provide minimum flows for a viable fishery on certain streams.	Stream miles	188	70	0	70	188	0	188	188	0	188
8. Maintain fishing stream quality.	Stream miles	1,460	584	0	584	1,460	0	1,460	1,460	0	1,460
9. Create and enhance waterfowl habitat.											
Create	Acres	7,800	7,800	0	7,800	7,800	0	7,800	7,800	0	7,800
Enhance	Acres	19,000	19,000	0	19,000	19,000	0	19,000	19,000	0	19,000
10. Enhance and protect critical wildlife winter habitat for:											
Antelope	Acres	1,762,000	1,762,000	1,126,500	635,500	1,762,000	1,260,300	501,700	1,762,000	1,394,000	368,000
Mule deer	Acres	1,030,000	1,030,000	384,000	646,000	1,030,000	520,000	510,000	1,030,000	656,000	374,000
Elk	Acres	766,000	766,000	547,780	218,300	766,000	594,700	171,300	766,000	641,600	124,400
Moose	Acres	328,000	328,000	234,900	93,000	328,000	254,500	73,500	328,000	274,100	53,900
11. Utilize available Colorado River Compact water.	Acre-feet (annually)	805,000 2/	805,000	455,100	349,900	805,000	571,300	233,700	805,000	616,800	188,200

1/ Quantities indicated include previous time frame amounts.
2/ Represents minimum water available to Wyoming under the Colorado River Compact as estimated by the Department of Interior. Available for new uses: 188,200 acre-feet after accounting for projected commitments through 2020.

CHAPTER VIII

LAND AND WATER DEVELOPMENT PLANNING ALTERNATIVES

CHAPTER VIII
LAND AND WATER DEVELOPMENT PLANNING ALTERNATIVES

This chapter presents planning alternatives to satisfy resource needs identified in Chapter VII. At the request of the State Sponsor, a preferred or selected plan was not developed. Instead, three planning alternatives were formulated to assist residents of the basin, local units of government, and the State of Wyoming with the management and development of land and water resource potentials in the Green River Basin. Component needs for alternatives were identified from the study objectives presented at the end of Chapter III. These needs gave guidance for the conduct of the study as well as providing a basis for formulation of the planning alternatives. Identified component needs were grouped into single packages which are referred to as planning alternatives. It should be noted that the grouping of needs and plan elements varies between alternatives because of the different emphasis given each alternative. The planning alternatives are named A (NED), B (EQ), and C (local desires and preferences). Planning alternative A emphasizes national economic development; planning alternative B emphasizes environmental quality; and planning alternative C emphasizes regional and local preference for resource use and development. This chapter and the following chapter analyze only needs identified for the year 2000.

Land and water right implications were not analyzed for the plan elements in each planning alternative. All institutional implications of this nature would need to be investigated in detail if plan elements are selected for implementation. Water rights and appropriations must be coordinated with the State Engineer's office. Land rights determinations and transactions would be administered through various county offices. Also, the potential uses of water identified by the various planning alternatives does not mean that these are the only potential uses for that water.

Expected impacts or effects of the various plan elements were analyzed from three viewpoints or accounts: (1) economic; (2) environmental; and (3) social well-being. Beneficial effects in the economic development account reflect increased production of goods and services and/or gains in production efficiency. Benefits are presented on an average annual basis. Adverse effects in the economic account reflect the value of resources needed to implement the plan element. The adverse effects are also estimated on an average annual basis. The average annual costs displayed in the accounts include such items as land acquisition, construction, maintenance and administration. Federal and regional (local) cost shares are estimated and displayed in the account.

Effects displayed in the environmental account reflect favorable and deleterious contributions to the environment from the implementation of a plan element. Effects in the social well-being account reflect impacts of the plan element on the amount and distribution of income, employment, health and safety, education, cultural and other social

activities. Since the nature of environmental and social well-being effects--whether beneficial or adverse--is often a personal judgement, no distinction was made in the accounts.

NATIONAL ECONOMIC DEVELOPMENT PLANNING ALTERNATIVE (ALTERNATIVE A)

This planning alternative was formulated to enhance national economic development by increasing the value of the nation's output of goods and services and improve national economic efficiency. Fully implemented, this planning alternative would include the following plan elements:

1. Install two irrigation storage structures and initiate irrigation water management systems on 4,000 acres. Storage structures are on Fall Creek (Burnt Lake) and Silver and Spring Creeks. (Of the 54,100 acres, 26,400 would have full supply at 50 percent efficiency, and 27,700 would still need more water).

2. Initiate salinity studies on two watersheds and implement measures recommended by studies to reduce salinity in the Colorado River system on three watersheds. (Big Sandy watershed is currently under USDA study.)

3. Encourage additional timber sale permits on Forest Service land to increase annual harvest for fuelwood to 2,170 cords; for the number of posts to 1,650; and for the number of poles to 8,350.

4. Install commercial forest land treatment measures on 125,000 acres. Practices include site preparation and planting on 45,000 acres and thinning on 80,000 acres. Increase timber sale offerings on Forest Service land to harvest annually 18.7 MMcu.ft. of roundwood from portions of commercial forest land (542,000 acres).

5. Accelerate installation of improved grazing management systems to reduce erosion. Practices and measures to reduce erosion include proper grazing use, fencing, water development, and grade stabilization structures.

6. Increase funding for recreation facilities by $642,100 annually. Detailed funding increases as follows:

Developed areas:	Maintenance - $151,700, Operation - $276,700
Dispersed areas:	Maintenance - $ 16,700, Operation - $ 62,500
Recreation trails:	Maintenance - $134,500

7. Install new recreation facilities as follows: 8 boat launching sites, 79 picnic grounds (3 units each), 7 campgrounds (25 units each), and acquire public access to 140 miles of fishing stream.

Implementation of plan elements would satisfy specific study objectives as follows:

1. Improve irrigation water supplies for late season use on 30,400 acres.

2. Reduce salt loading to the Green River from the Big Sandy and Blacks Forks River and Henrys Fork.

3. Improve irrigation efficiency on 52,500 acres. (Plan elements that satisfy specific Study Objectives 1 and 2 result in improved irrigation efficiency in excess of 52,500 acres. Therefore, this Study Objective and its effects are not displayed in the account tables for Alternative A.)

4. Increase the utilization of fuelwood and small wood products to the following levels: 2,170 cords of fuelwood, 1,650 posts and 8,350 poles.

5. Increase wood fiber production by 5.1 MMcu.ft. and harvest by 18.7 MMcu.ft.

6. Reduce erosion on 1,026,300 acres of rangeland.

7. Improve management of the present recreation activity opportunities and recreation facility maintenance program on all developed sites, dispersed areas, and recreation trails.

8. Increase recreation facilities:

    a. Boating, eight launching sites
    b. Camping, seven campsites with 27 units each
    c. Picnicking, 79 picnic grounds with 3 units each
    d. Fishing, 140 miles of stream with access

9. Utilize 29,900 ac. ft. of available Colorado River Compact water in basin. (The 29,900 ac. ft. of water is from the plan element that satisfies specific Study Objective 1. No other projects to use available water were feasible using national economic development criteria. Therefore, this Study Objective and its effects are not displayed in the account tables for alternative A.)

10. Increase production of winter livestock forage by 100,000 AUMs. (Plan elements that satisfy Study Objectives 1, 2, and 3 result in forage production in excess of 100,000 AUMs. Therefore, this Study Objective and its effects are not displayed in the account tables for alternative A.

ENVIRONMENTAL QUALITY PLANNING ALTERNATIVE (ALTERNATIVE B)

This planning alternative outlines programs and developments that would provide for the protection and enhancement of the environment. The impacts of effects of each element are described under the three accounts previously mentioned. Fully implemented, this planning alternative would include the following plan elements:

1. Enact local protective zoning with tax credits on 800 miles (38,000 acres) of stream corridor. Install land treatment measures such as proper grazing systems, fencing, and tree planting; and purchase scenic easements on 370 miles (17,900 acres) of stream corridor.

2. Initiate an entry permit system, employ personnel to operate entrance stations, employ more wilderness patrol personnel, relocate trails, remove some cabins, and improve animal and human waste management on Forest Service recreation areas.

3. Accelerate the general reconnaissance of the basin for archeological resources on 344,000 acres and for paleontological resources on 3,578,500 acres.

4. Install roads, signs, parking areas, and foot trails on historic site areas. Initiate scheduled operations, maintenance, police patrols, and necessary replacements. Historic sites by counties are: Carbon - 3, Fremont - 25, Sublette - 17, Sweetwater - 46, and Uinta - 22.

5. Accelerate installation of improved grazing management systems on rangeland to reduce erosion. Practices and measurements to reduce erosion include proper grazing use, fencing, water development, and grade stabilization structures.

6. Install streambank stabilization structures, grade stabilization structures, fences, adaptable trees and shrubs, and institute proper grazing use along 200 miles of stream.

7. Enact a minimum streamflow law for fish and other aquatic resources. Store 36,000 ac. ft. of water in impoundments to annually augment flows for fish between September 1 through May 1 on following streams: Fontenelle Creek - 25 miles; Middle Piney Creek - 9 miles; LaBarge Creek - 30 miles; South Horse Creek - 6.5 miles; Tosi Creek - 14 miles. Augment streamflows on Hams Fork - 34 miles and Green River below Fontenelle Dam 69.5 miles by releasing necessary water from existing reservoirs.

8. Accelerate landowner cooperation program to further protect and rehabilitate fishing streams. Enact a stream protection law in Wyoming.

9. Install waterfowl habitat improvement measures on 4,800 acres of wetland and create 7,800 acres of wetland.

10. Accelerate installation of wildlife habitat improvement practices on critical winter range. Habitat types to improve are: antelope - 501,700 acres; mule deer - 510,000 acres; elk - 171,300 acres and moose - 73,500 acres.

Implementation of plan elements would satisfy specific study objectives as follows:

1. Protect 800 miles of stream corridors in visual classes 3,4, and 5, and enhance 370 miles of scenic stream corridors in visual classes 1 and 2.

2. Reduce concentrated use in local areas within nine wilderness management units.

3. Identify and protect potential archeological resources on 344,000 acres and fossil resources on 3,565,000 acres.

4. Preserve and improve 113 historical sites.

5. Reduce erosion on 1,026,300 acres of rangeland.

6. Reduce streambank erosion on 200 miles of stream.

7. Provide minimum flows for a viable fishery on 188 miles of stream.

8. Maintain fishing stream quality on 1,360 miles.

9. Enhance 4,800 acres and create 7,800 acres of waterfowl habitat.

10. Enhance and protect critical winter habitat for:

    a. Antelope, 501,700 acres.
    b. Mule deer, 510,000 acres.
    c. Elk, 171,300 acres.
    d. Moose, 73,500 acres.

11. Utilize 20,000 acre-feet of unused Colorado River Compact water in basin. (The 20,000 acre-feet of water is from the plan element that satisfied specific Study Objective 9. No other potential water use projects to use available water were identified using environmental criteria.)

ALTERNATIVE C

Alternative C provides for the development of land and water resources which improves the economy and enhances the environment of the Green River Basin. The degree of resource development and protection detailed by this alternative was formulated using the feedback at public meetings and the philosophies and goals of local and state agencies as a guide. The beneficial and adverse effects for each plan element are described under the system of accounts. Fully implemented, this planning alternative would include the following plan elements:

1. Install two irrigation storage structures and initiate irrigation water management systems on 4,000 acres. Storage structures are on Fall Creek (Burnt Lake) and Silver and Spring Creeks.

2. Install six irrigation storage structures and initiate irrigation water management systems on 44,200 acres. Storage structures are on Horse Creek (2 sites), North Piney Creek (1 site) and Middle and South Piney Creeks (3 sites). Accelerate land treatment to improve irrigation efficiency on the remaining 9,900 acres having water shortages.

3. Encourage additional timber sale permits on Forest Service land to increase annual harvest for fuelwood to 2,170 cords; for the number of posts to 1,650; and for the number of poles to 8,350.

4. Install commercial forest land treatment measures on 75,000 acres. Practices include site preparation and planting on 24,000 acres and thinning on 51,000 acres. Increase timber sale offerings on Forest Service land to harvest annually 7.4 MMcu.ft. of roundwood from portions of commercial forest land (542,000 acres).

5. Install grazing management systems on 513,000 acres of rangeland to reduce erosion. Practices to reduce erosion include grazing management, fencing, water developments, and grade stabilization structures.

6. Install streambank stabilization structures, grade stabilization structures, fences, adaptable trees and shrubs, and institute proper grazing use along 100 miles of stream.

7. Increase funding for recreation facilities by $642,100 annually. Detailed funding increases as follows:

   Developed areas: Maintenance - $151,700, Operation - $276,700
   Dispersed areas: Maintenance - $ 16,700, Operation - $ 62,500
   Recreation trails: Maintenance - $134,500

8. Install new recreation facilities as follows: 8 boat launching sites; 79 picnic grounds (3 units each), 7 campgrounds (25 units each), and acquire public access to 562 miles of fishing stream.

9. Enact local protective zoning with tax credits on 800 miles (38,800 acres) of stream corridor.

10. Initiate a use permit system, employ personnel to operate entrance stations, employ more wilderness patrol personnel, relocate trails, remove some cabins, and improve animal and human waste management on Forest Service recreation areas.

11. Accelerate the general reconnaissance of the basin for archeological resources on 172,000 acres and for paleontological resources on 1,789,000 acres.

12. Install roads, signs, parking areas, and foot trails on historic site areas. Initiate scheduled operations, maintenance, police patrols, and necessary replacements. Historic sites by counties are: Carbon - 3, Fremont - 25, Sublette - 17, Sweetwater - 23, and Uinta - 22.

13. Enact a minimum streamflow law for fish and other aquatic resources. Law should allow appropriation of water for fish (nonconsumptive use) in existing reservoirs if supply is available.

14. Accelerate landowner cooperative program to further protect and rehabilitate fishing streams. Enact and enforce a stream protection law in Wyoming.

15. Install waterfowl habitat improvement measures on 4,800 acres of wetland and create 7,800 acres of wetland.

16. Accelerate installation and initiation of wildlife habitat improvement practices on critical winter range (see note below). Habitat types to improve are: antelope - 251,000 acres; mule deer - 255,000 acres; elk - 171,300 acres; and moose - 73,500 acres.

17. Construct dams with sufficient active storage capacity to store 110,000 acre-feet of available Colorado Compact water. Storage sites on Pine Creek (Fremont Lake) and Boulder Creek (Boulder Lake) are the most economical to construct.

Implementation of plan elements would satisfy specific study objectives as follows:

1. Improve irrigation water supplies for late season use on 48,200 acres.

2. Improve irrigation efficiency on 48,200 acres. (Plan element for specific Study Objective 1 improves efficiency on 48,200 acres. Therefore, this Study Objective and its effects are not displayed in the account tables for alternative C.)

3. Increase the utilization of fuelwood and small wood products to the following levels: 2,170 cords of fuelwood, 1,650 posts and 8,350 poles.

4. Increase wood fiber production by 5.1 MMcu.ft. and maintain harvest at 1970 level of 7.4 MMcu ft.

5. Reduce erosion on 513,000 acres of rangeland.

6. Reduce erosion on 100 miles of streambanks.

7. Improve management of the present recreation activity opportunities and recreation facility maintenance program for all developed recreation sites, dispersed areas, and recreation trails.

8. Increase recreation facilities:

   a. Boating, 8 launching sites
   b. Camping, 7 campgrounds with 25 units each
   c. Picnicking, 79 picnic grounds with 3 units each
   d. Fishing, 562 miles of stream with access

9. Increase production of winter livestock forage by 100,000 AUMs. (Plan elements that satisfy specific Study Objectives 1 and 2 will result in forage production in excess of 100,000 AUMs. Therefore, this Study Objective and its effects are not displayed in the account tables for alternative C.)

10. Protect and enhance 800 miles of scenic stream corridors.

11. Reduce concentrated use in local areas within nine wilderness management units.

12. Identify and protect 172,000 acres of archeological resources and 1,789,000 acres of fossil areas.

13. Preserve and improve 90 historical sites.

14. Provide minimum flows for a viable fishery on 174 miles of stream.

15. Maintain fishing stream quality on 1,460 miles.

16. Enhance 4,800 acres and create 7,800 acres of waterfowl habitat.

17. Enhance and protect critical winter habitat for:

    a. Antelope, 251,000 acres.
    b. Mule deer, 255,000 acres.
    c. Elk, 171,300 acres.
    d. Moose, 73,500 acres.

18. Utilize 188,200 acre-feet of available Colorado River Compact water in basin.

There follows tables and displays of study objectives for three planning alternatives: (1) National Economic Development (NED), Alternative A; (2) Environmental Quality (EQ), Alternative B; and (3) Local and Regional Desires, Alternative C. Table VIII-1 compares the agricultural output for each planning alternative with the OBERS E' projections. Table VIII-2 shows the capability of each alternative to satisfy the needs (which were presented in Tables VII-1 and VII-2) for the year 2000. Table VIII-3 is a summary comparison of economic, environmental and social effects of the planning alternatives for the year 2000. The group of displays for each planning alternative includes the specific study objectives, plan elements to satisfy those objectives, and the economic, environmental, and social effects of the plan elements. Following the group of displays for each alternative there is a summary table of the various effects.

Table VIII-1 Comparison of planning alternatives with OBERS E' projections - year 2000, Green River Basin, Wyoming

Items	OBERS E'	Alternative A (NED)	Comparison NED-OBERS	Alternative B (EQ)	Comparison EQ-OBERS	Alternative C	Comparison C-OBERS
AGRICULTURAL PRODUCTION							
Livestock (100 lbs. of meat)	83,436.3	90,251.1	+6,814.8	65,938.4 1/	-17,497.9	90,251.1	+6,814.8
TIMBER HARVEST							
Wood fiber (MM.cu.ft.)	84.0	21.7	-62.3	3.0	-81.0	7.4	-76.6

1/ Keeping livestock numbers at 1974 levels.

Table VIII-2 Capability of planning alternatives to satisfy year 2000 needs, Green River Basin, Wyoming

Specific study objectives	Unit of measure	Year 2000 total need 1/	Alternative A (NED) Needs satisfied	Alternative A (NED) Remaining needs	Alternative B (EQ) Needs satisfied	Alternative B (EQ) Remaining needs	Alternative C Needs satisfied	Alternative C Remaining needs
1. Improve irrigation water supplies for late season use.	Acres	58,100	30,400	27,700	0	58,100	48,200	9,900
2. Reduce salt loading to the Green River from the Big Sandy and Blacks Forks Rivers and Henrys Fork.	Watershed	3	3	0	0	3	0	3
3. Improve irrigation water use efficiency.	Acres	52,500	52,500 2/	0	0	52,500	48,200 2/	4,300
4. Increase the utilization of fuelwood and small wood products annually.	Cords (each)	2,170	2,170	0	0	2,170	2,170	0
	Posts (each)	1,650	1,650	0	0	1,650	1,650	0
	Poles (each)	8,350	8,350	0	0	8,350	8,350	0
5. Increase annual roundwood: production	MMcu.ft.	5.1	5.1	0	0	5.1	5.1	0
harvest	MMcu.ft.	18.7	18.7	0	0	18.7	7.4	11.3
6. Reduce erosion on rangeland.	Acres with erosion rate below 0.5 ton/ac./yr. (thousands)	1,026.3	1,026.3	0	1,026.3	0	513	513
7. Improve management of the present recreation activity opportunities and recreation facility maintenance program.	Dollars (annually)	642,100	642,100	0	0	642,100	642,100	0
8. Increase recreation facilities.								
Boat launching sites	Sites (no.)	8	8	0	0	8	8	0
Picnic grounds	Sites (no.)	79	79	0	0	79	79	0
Campgrounds	Sites (no.)	7	7	0	0	7	7	0
Fishing-streams with access	Stream miles	562	140	422	0	562	562	0
9. Utilize available Colorado River Compact water in basin.	Acre-feet (annually)	188,200 3/	29,900 4/	158,300	20,000	168,200	188,200	0
10. Increase production of winter livestock forage.	AUMs (annually)	100,000	100,000 5/	0	0	100,000	100,000 5/	0
11. Protect and enhance scenic stream corridors.	Protected miles of stream corridor	1,170	0	1,170	1,170	0	800	370
12. Reduce concentrated use in local areas within wilderness management units	Number of properly managed wilderness mgmt. units	9	0	9	9	0	9	0
13. Identify and protect significant archeologic and fossil areas.	Acres reconned							
	archeological	344,000	0	344,000	344,000	0	72,000	172,000
	fossil	3,578,500	0	3,578,500	3,578,500	0	1,789,000	1,789,000
14. Preserve and improve historical sites.	Sites adequately protected	113	0	113	113	0	90	23
15. Reduce streambank erosion.	Miles of stream	200	0	200	200	0	100	100
16. Provide minimum flows for a viable fishery on certain streams.	Miles of stream	188	0	188	188	0	174	14
17. Maintain fishing stream quality.	Miles of stream	1,460	0	1,460	1,460	0	1,460	0
18. Enhance and create waterfowl habitat.	Acres - enhanced	19,000	0	19,000	4,800	14,200	4,800	14,200
	created	7,800	0	7,800	7,800	0	7,800	0
19. Enhance and protect critical winter habitat for selected resident wildlife species.	Antelope (acres)	501,700	0	501,700	501,700	0	251,000	250,700
	Mule deer (acres)	510,000	0	510,000	510,000	0	255,000	255,000
	Elk (acres)	171,300	171,300	0	171,300	0	171,300	0
	Moose (acres)	73,500	0	73,500	73,500	0	73,500	0

1/ Year 2000 need includes 1980 time frame need.
2/ Needs satisfied by plan elements for specific Study Objectives 1 and 2. Objective 2 improves efficiency on 43,600 acres.
3/ Need figure occurring here is for the year 2020.
4/ Includes agricultural and potential industrial water.
5/ Needs satisfied by plan elements for specific Study Objectives 1, 2, 3 and 6 exceed 100,000 AUMs.

Table VIII-3 Summary comparison of planning alternative effects for year 2000, Green River Basin, Wyoming

Accounts	Unit	Plan A (NED)	Plan B (EQ)	Plan C	Plan C Minus A	Plan C Minus B
A. ECONOMIC DEVELOPMENT						
1. Plan elements evaluated for benefits and costs						
a. Beneficial effects	Av. Ann. $	13,560,300	--	15,278,500[1/]	+1,718,200	+15,278,500
b. Adverse effects	Av. Ann. $	11,915,600	--	8,961,800	-2,993,700	+8,921,900
c. Net beneficial effects	Av. Ann. $	+ 1,644,700	--	+6,316,700[1/]	+4,711,900	+6,356,600
2. Plan elements evaluated for costs only						
a. Beneficial effects - not evaluated in monetary terms, benefits assumed at least equal to costs	--	--	--	--	--	--
b. Adverse effects	Av. Ann. $	2,809,600	3,672,900	2,005,700	-803,900	-1,622,200
B. ENVIRONMENTAL QUALITY (Beneficial and adverse effects)						
1. Areas of natural beauty						
a. Change rangeland and forest land to recreation facilities.	Acres	161	0	245	+84	+245
b. Improve recreation site aesthetics.	Yes or No	Yes	No	Yes	--	--
c. Preserve and enhance scenic stream corridors.	Miles	0	1,660	2,360	+2,360	+700
d. Decrease visual quality by increasing activity [illegible] commercial forest land.	Yes or No	Yes	No	Yes	--	--
e. Improve visual quality on rangeland.	Acres	1,026,300	1,026,300	513,000	-513,000	-513,000
2. Quality consideration of water, land, and air resources.						
a. Improve water quality by decreasing TDS (amount undetermined), and nutrients entering the Green River and reservoirs.	Yes or No	Yes	No	Yes	--	--
b. Increase forage production.	AUMs	203,600	20,500	198,300	-5,300	+177,800
c. Improve irrigation efficiency.	Acres	101,700		48,200	-53,500	+48,200
d. Reduce soil erosion on rangeland, roads and trails.	Acres	1,026,300	1,026,300	513,000	- 513,300	- 513,300
e. Increase human activity on recreation areas.	Yes or No	Yes	No	Yes	--	--
f. Increase human activity on new accessible streams.	Miles	140	0	562	+422	+562
g. Reduce erosion and sedimentation on streams.	Miles	0	200	100	+100	-100
h. Increase erosion and sediment during construction and logging.	Yes or No	Yes	Yes	Yes	--	--
i. Reduce Green River water discharge to Colorado River.	Yes or No	Yes	No	Yes	--	--
j. Increase human activities on commercial forest land.	Yes or No	Yes	No	Yes	--	--
k. Improve fish management [illegible] streams.	Yes or No	Yes	Yes	Yes	--	--
l. Decrease forest fire, disease, and insect hazards.	Yes or No	Yes	No	Yes	--	--
m. Harvest timber in wilderness study and roadless areas.	Yes or No	Yes	No	Yes	--	--
n. Reduce use concentration in wilderness area from people and livestock.	Management unit	0	9	9	+9	0
3. Biological resources and selected ecosystems						
a. Increase open water wetlands.	Acres	635	957	1,883	+1,248	+926
b. Inundate perennial streams.	Miles	3	14	[illegible]	+5	-6
c. Inundate terrestrial wildlife habitat.	Acres	635	5,957	6,883	+6,248	+926
d. Decrease phreatophytes and associated wildlife along streams.	Yes or No	Yes	No	Yes	--	--
e. Reduce stream flow fluctuations.	Yes or No	Yes	Yes	Yes	--	--
f. Improve channel crossing for livestock and wildlife.	Yes or No	No	Yes	Yes	--	--
g. Preserve fishing stream habitat.	Miles	0	1,460	1,460	+1,460	0
h. Create waterfowl breeding habitat.	Acres	0	7,800	7,800	+7,800	0
i. Enhance waterfowl breeding habitat.	Acres	0	4,800	4,800	+4,800	0
j. Improve critical winter habitat for big game animals.						
1. Antelope	Acres	0	501,700	251,000	+251,000	-250,700
2. Mule Deer	Acres	0	510,000	255,000	+255,000	-255,000
3. Elk	Acres	0	171,300	171,300	+171,300	0
4. Moose	Acres	0	73,500	73,500	+ 73,500	0
k. Reduce waterfowl habitat associated with cropland.	Ac. of cropland	101,700	0	58,100	- 43,600	+ 58,100
4. Irreversible or irretrievable commitment of resources						
a. Commit rangeland and forest land to recreation areas.	Acres	161	0	245	+84	+245
b. Commit perennial stream to reservoir.	Miles	3	14	[illegible]	+5	-6
c. Commit Colorado River Compact water to various uses.	Acre-feet	29,900	20,000	188,200	+158,300	+168,200
d. Consume fossil fuels during construction.	Yes or No	Yes	Yes	Yes	--	--
C. SOCIAL WELL-BEING (Beneficial and adverse effects)						
1. Create temporary jobs during installation of structures and land treatment.	Jobs	504	738	1,059	+555	+321
2. Create permanent jobs.	Jobs	585	7	135	-450	+128
3. Create seasonal jobs.	Jobs	97	10	114	+17	+104
4. Improve ranch unit stability.	Yes or No	Yes	No	Yes	--	--
5. Improve recreation experience for visitors.	Yes or No	Yes	No	Yes	--	--
6. Utilize Colorado River Compact water in Wyoming.	Acre-feet	29,900	20,000	188,200	+158,300	+168,200
7. Reduce landowner rights along streams.	Acres	0	91,800	91,800	+ 91,800	0
8. Improve overall hunting quality.	Yes or No	No	Yes	Yes	--	--
9. Increase hunting opportunities.	Yes or No	No	Yes	Yes	--	--
10. Improve fishing quality.	Yes or No	No	Yes	Yes	--	--
11. Increase fishing opportunities.	Yes or No	Yes	No	Yes	--	--
12. Discover, protect or enhance archeological resources.	Acres	0	344,000	172,000	+172,000	-172,000
13. Discover, protect or enhance fossil resources.	Acres	0	3,578,500	1,789,000	+1,789,000	-1,789,500
14. Discover, protect or enhance historical resources.	Sites	0	113	90	+90	-23
15. Harvest renewable wood fiber resources on commercial forest land	Yes or No	Yes	No	Yes	--	--
16. Increase human activities on water area and associated land.	Acres	735	9,100	10,575	+ 9,840	+1,475
17. Increase or improve accessibility to commercial forest land.	Yes or No	Yes	No	Yes	--	--
18. Decrease number of visitors at certain times, limit choice of areas and limit motor vehicle use.	Yes or No	No	Yes	Yes	--	--
19. Decrease livestock grazing on critical winter range for wildlife.	Acres	0	1,256,500	750,800	-505,700	+750,800
20. Reduce future opportunities to appropriate water for agriculture.	Yes or No	No	Yes	Yes	--	--
21. Reduce real estate taxes to landowners.	Yes or No	No	Yes	Yes	--	--
22. Reduce tax revenue to local governments.	Yes or No	No	Yes	Yes	--	--
23. Provide more flexibility for meeting Colorado River Compact water commitments.	Yes or No	No	No	Yes	--	--
24. Protect natural resources for future generations.	Yes or No	No	Yes	Yes	--	--

1/ Includes direct and external benefits. See definitions of these benefits on individual display sheets for specific study objectives in Alternative C.

STUDY OBJECTIVE DISPLAYS

AND CORRESPONDING PLAN ELEMENT ANALYSES

WITHIN EACH

PLANNING ALTERNATIVE

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE A-NATIONAL ECONOMIC DEVELOPMENT (NED)-YEAR 2000

Specific Study Objective - Improve irrigation water supplies for late season use on 58,100 acres.

Plan Element - Install two irrigation storage structures and initiate irrigation water management systems on 4,000 acres. Storage structures are on Fall Creek (Burnt Lake) and Silver and Spring Creeks. Accelerate land treatment to improve irrigation efficiency on remaining 54,100 acres that have water shortages. (Of the 54,100 acres, 26,400 would have full supply at 50 percent efficiency, and 27,700 would still need more water.)

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

1. Increase winter forage production by 15,600 AUMs.	60,300
2. Nonagricultural benefits 2/	452,500
3. Total Beneficial Effects	$ 512,800

NOTE: Benefits of accelerated land treatment program for the 54,100 acres not evaluated in monetary terms. Benefits assumed at least equal to costs. Total treatment installation costs are $8,115,000 (estimated 50 percent region cost and 50 percent rest of nation cost). Average annual costs at 6 5/8 percent for 15 years are $870,000. Technical assistance costs are $1,623,000, a rest of nation cost. Average annual costs are $174,000.

ADVERSE EFFECTS 1/

	REGION	REST OF NATION
1. Storage structure construction costs $5,929,000	196,700	196,700
2. Land and water rights $644,000	22,000	0
3. Operation, maintenance, replacement	12,100	0
4. Administration $208,000	2,800	11,000
5. Engineering services $320,000	0	21,200
6. Relocation costs $50,000	1,700	1,700
Subtotal	235,300	230,600
Total Adverse Effects	$ 465,900	
Net Beneficial Effects 3/	+ $ 46,900	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Increase lake habitat for waterfowl, aquatic mammals, and fish by 635 surface acres.
2. Destroy 3 miles of perennial stream through inundation.
3. Destroy 635 acres of terrestrial wildlife habitat through inundation.
4. Reduce streamflow fluctuations.
5. Reduce streamflow discharges from the Green River to the Colorado River.
6. Increase sedimentation during construction.
7. Reduce waterfowl habitat associated with 58,100 acres of cropland by improving water delivery and application systems.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 118 temporary jobs during installation period.
2. Create 1 permanent job for maintenance.
3. Improve economic stability of ranch units.
4. Increase human activity on 735 acres of land and water.
5. Utilize 29,900 acre-feet of available Colorado River Compact water (2,050 acre-feet is for agriculture.)
6. Provide local waterfowl hunting on reservoirs and adjacent land.
7. Improve irrigation efficiency on 58,100 acres.
8. Consume fossil fuels during construction.

1/ Average annual costs amortized 100 years @ 6 5/8 percent interest.
2/ Nonagricultural benefits assume that industry, municipalities, recreation facilities and fish and wildlife developments will buy remaining available water at cost.
3/ Water shortages on Fall Creek can be satisfied with a smaller project that has agricultural benefits which exceed costs. Average annual installation costs to satisfy only irrigation shortages would be $17,800 (includes OM&R) and agricultural benefits would be $28,600.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE A-NATIONAL ECONOMIC DEVELOPMENT (NED)-YEAR 2000

Specific Study Objective - Reduce agricultural contributions to salt loading in the Green River from the Big Sandy and Blacks Forks Rivers and Henrys Fork.

Plan Element - Initiate salinity studies on two watersheds and implement measures recommended by studies to reduce salinity in the Colorado River system on three watersheds. (Big Sandy watershed is currently under USDA study).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Downstream effects not evaluated in monetary terms. It has been estimated that a reduction of 1 ppm total dissolved solids (TDS) in the Colorado River would be worth $430,000 annually to the rest of the nation. This amount is derived from estimated costs of desalination. The specific study objective is considered necessary to satisfy U.S. water quality and the international treaty with Mexico involving Colorado River water.

NOTE: Accelerated land treatment benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS 1/

	REGION	REST OF NATION
1. Installation costs of land treatment on 43,600 acres of treatable irrigated pasture and cropland at 150.00/acre 2/ $6,540,000	175,300	526,000
2. Technical assistance $1,308,000	0	140,200
Subtotal	175,300	666,200
Total Adverse Effects		$ 841,500

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Improve water quality in the Colorado River by decreasing TDS by an undetermined amount.
2. Decrease phreatophyte vegetation and associated terrestrial wildlife.
3. Reduce waterfowl habitat associated with 43,600 acres of cropland by improving water delivery and application system.
4. Increase forage production on pasture and hayland by 167,500 AUMs.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Improve agricultural efficiency on individual farm units covering 43,600 acres.
2. Create 95 temporary jobs during installation of land treatment measures.

1/ Amortized for 15 years at 6 5/8 percent interest.
2/ Average cost/acre @ 150.00 from Yellowstone Basin Study data. Assumed 75 percent cost share and technical assistance 20 percent.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE A-NATIONAL ECONOMIC DEVELOPMENT (NED)-YEAR 2000

Specific Study Objective - Increase the utilization of fuelwood and small wood products.

Plan Element - Encourage additional timber sale permits on Forest Service land to increase annual harvest for fuelwood to 2,170 cords; for the number of posts to 1,650; and for the number of poles to 8,350.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS 1/

Benefits resulting from the sale of fuelwood, posts and poles.	110,200
Total Beneficial Effects	110,200

ADVERSE EFFECTS 2/

			REGION	REST OF NATION
1.	Costs for increased harvest, including logging and hauling. 3/	fuelwood	54,300	0
		posts	1,800	0
		poles	13,700	0
	Subtotal		69,800	0
	Total Adverse Effects		$ 69,800	
	Net Beneficial Effects		+ $ 40,400	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Increase human activity on commercial forest land.
2. Decrease fire, disease and insect hazards.

**Other environmental effects are included in display for roundwood harvest.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Create 2 permanent jobs.
2. Alter visual quality on commercial forest land over 20 year period.

1/ Annual benefits from harvest.
2/ Annual costs for harvest.
3/ Forest Service administrative costs not included.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE A-NATIONAL ECONOMIC DEVELOPMENT (NED)-YEAR 2000

Specific Study Objective- Increase roundwood production by 5.1 MMcu.ft. and harvest by 18.7 MMcu.ft.

Plan Element- Install commercial forest land treatment measures on 125,000 acres. Practices include site preparation and planting on 45,000 acres and thinning on 80,000 acres. Increase timber sale offerings on Forest Service land to harvest annually 18.7 MMcu.ft. of roundwood from portions of commercial forest land (542,000 acres).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS 1/

1. Benefits accruing to roundwood sales at the mill.	11,000,000
Total Beneficial Effects	$11,000,000

ADVERSE EFFECTS 2/

	REGION 2/	REST OF NATION 2/
1. Cost of forest land treatment $6,875,000	59,000	285,000
2. Costs for harvest include stumpage, logging and hauling to the mill. 3/ 4/	9,620,000	0
Subtotal	9,679,000	285,000
Total Adverse Effects	$ 9,964,000	
Net Beneficial Effects	+ $ 1,036,000	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Alter wildlife habitat on portions of commercial forest over 20 year period.
2. Increase soil erosion during logging operations.
3. Increase human activity on commercial forest over 20 year period.
4. Harvest roundwood on present wilderness study and roadless areas.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Create 550 permanent jobs.
2. Increase and improve accessibility to commercial forest over 20 year period.
3. Alter visual quality on commercial forest over 20 year period.
4. Harvest a renewable resource.
5. Consume nonrenewable fossil fuels during harvest and manufacture of roundwood.
6. Increase hunting days by improving access and increasing wildlife during re-establishment of timber stands.

1/ Annual benefits from harvest.
2/ Annual costs for treatment and harvest.
3/ Forest Service administrative costs not included.
4/ Timber harvest in Green River Basin is highly constrained by wildlife and aesthetic considerations and roadless areas.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE A-NATIONAL ECONOMIC DEVELOPMENT (NED)-YEAR 2000

Specific Study Objective - Reduce erosion on 1,026,300 acres of rangeland.

Plan Element - Accelerate installation of improved grazing management systems to reduce erosion. Practices and measures to reduce erosion include proper grazing use, fencing, water development, and grade stabilization structures. (See Figure V-6).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Acceleration of improved grazing management systems not evaluated in monetary terms. Benefits are assumed at least equal to costs.

ADVERSE EFFECTS 1/

	REGION	REST OF NATION
1. Installation costs for improved grazing management systems 2/ $7,184,000	154,000	616,100
2. Technical assistance 3/ $1,437,000	0	154,000
Subtotal	154,000	770,100
Total Adverse Effects		$ 924,100

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Reduce erosion on 1,026,300 acres of rangeland that have an erosion rate from 0.5 - 2.0 tons/acre/year to less than 0.5 tons/acre/year.
2. Improve the quality of terrestrial wildlife habitat on 1,026,300 acres.
3. Increase forage production by an estimated 20,500 AUMs by initiating grazing management.
4. Improve quality of coldwater fishing streams in rangeland areas.
5. Reduce sedimentation and phosphorus loading in reservoirs.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 240 temporary jobs during installation period.
2. Enhance visual quality on 1,026,300 acres.
3. Improve the quality of hunting on 1,026,300 acres.

1/ Assumed 15 year life, amortized at 6 5/8 percent interest.
2/ Cost per acre to treat estimated at $7.00 (from Yellowstone Level B Study), 60 percent acres est. public, 40 percent private ownership. Cost share on private assumed 50 percent. Land treatment assumed 15 year life and amortized at 6 5/8 percent.
3/ Cost for technical assistance based on 20 percent of total installation costs.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE A-NATIONAL ECONOMIC DEVELOPMENT (NED)-YEAR 2000

Specific Study Objective- Improve management of the present recreation activity opportunities and recreation facility maintenance program on all developed sites, dispersed areas, and recreation trails.

Plan Element- Increase funding by $642,100 annually. Detailed funding increases as follows:
Developed areas: Maintenance - $151,700 and Operation - $276,700
Dispersed areas: Maintenance - $ 16,700 and Operation - $ 62,500
Recreation trails: Maintenance - $134,500

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

1. Increase in quality of recreation visitor day 1/	785,000
Total Beneficial Effects	$ 785,000

ADVERSE EFFECTS 2/

	REGION	REST OF NATION
1. Operation of recreation activities and facilities	142,500	196,700
2. Maintenance of recreation facilities	127,200	175,700
Subtotal	269,700	372,400
Total Adverse Effects		$ 642,100
Net Beneficial Effects		+ $ 142,900

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Reduce erosion on roads and trails.
2. Increase recreation activities in localized areas.
3. Improve aesthetic quality of recreation sites.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 32 permanent jobs.
2. Create 60 seasonal jobs.
3. Improve recreation experience for visitors.
4. Consume fossil fuels during maintenance.
5. Update recreation facilities.

1/ Benefits calculated by estimating the increase in value of a recreation visitor day from a base of $.75 to $1.50
2/ Average annual costs.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE A-NATIONAL ECONOMIC DEVELOPMENT (NED)-YEAR 2000

Specific Study Objective- Increase recreation facilities.

Plan Element- Install new recreation facilities as follows: 8 boat launching sites, 79 picnic grounds (3 units each), 7 campgrounds (25 units each), and acquire access to 140 miles of fishing stream.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS 1/

1. Provide 219,360 visitor days.	1,152,300
Total Beneficial Effects	$1,152,300

ADVERSE EFFECTS 2/

	REGION	REST OF NATION
1. Installation costs $2,534,700	135,900	135,900
2. Land rights $2,309,000	123,800	123,800
3. Operation, maintenance, replacement		65,800
4. Administration		61,400
Subtotal		386,900
Total Adverse Effects		$ 773,800
Net Beneficial Effects		+ $ 378,500

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Change 161 acres of rangeland or forest land to recreation facilities.
2. Increase human activity on land adjacent to new facilities.
3. Increase human activity on 140 miles of stream serviced by new access sites.
4. Improve fishery management on 140 miles of stream serviced by new access sites.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Create 51 temporary jobs during installation period.
2. Create 37 seasonal jobs.
3. Consume fossil fuels during construction.
4. Enhance opportunities for developed recreation experience.

1/ Average annual benefits based on $3.00/RVD for camping and picnicing with water setting and $9.00/RVD for front stream access and reservoir boating.
2/ Average annual costs amortized 15 years @ 6 5/8 percent interest.

Table VIII-4 Summary of planning alternative A effects for year 2000, Green River Basin, Wyoming

Accounts	Unit	Plan A (NED)
A. ECONOMIC DEVELOPMENT		
1. Plan elements evaluated for benefits and costs		
a. Beneficial effects	Av. Ann. $	13,560,300
b. Adverse effects	Av. Ann. $	11,915,600
c. Net beneficial effects	Av. Ann. $	+ 1,644,700
2. Plan elements evaluated for costs only		
a. Beneficial effects - not evaluated in monetary terms, benefits assumed at least equal to costs	--	--
b. Adverse effects	Av. Ann. $	2,809,600
B. ENVIRONMENTAL QUALITY (Beneficial and adverse effects)		
1. Areas of natural beauty		
a. Change rangeland and forest land to recreation facilities.	Acres	161
b. Improve recreation site aesthetics.	Yes or No	Yes
c. Preserve and enhance scenic stream corridors.	Miles	0
d. Decrease visual quality by increasing activity on commercial forest land.	Yes or No	Yes
e. Improve visual quality on rangeland.	Acres	1,026,300
2. Quality consideration of water, land, and air resources.		
a. Improve water quality by decreasing TDS (amount undetermined), and nutrients entering the Green River and reservoirs.	Yes or No	Yes
b. Increase forage production.	AUMs	203,600
c. Improve irrigation efficiency.	Acres	101,700
d. Reduce soil erosion on rangeland, roads and trails.	Acres	1,026,300
e. Increase human activity on recreation areas.	Yes or No	Yes
f. Increase human activity on new accessible streams.	Miles	140
g. Reduce erosion and sedimentation on streams.	Miles	0
h. Increase erosion and sediment during construction and logging.	Yes or No	Yes
i. Reduce Green River water discharge to Colorado River.	Yes or No	Yes
j. Increase human activities on commercial forest land.	Yes or No	Yes
k. Improve fish management on streams.	Yes or No	Yes
l. Decrease forest fire, disease, and insect hazards.	Yes or No	Yes
m. Harvest timber in wilderness study and roadless areas.	Yes or No	Yes
n. Reduce use concentration in wilderness area from people and livestock.	Management unit	0
3. Biological resources and selected ecosystems		
a. Increase open water wetlands.	Acres	635
b. Inundate perennial streams.	Miles	3
c. Inundate terrestrial wildlife habitat.	Acres	635
d. Decrease phreatophytes and associated wildlife along streams.	Yes or No	Yes
e. Reduce stream flow fluctuations.	Yes or No	Yes
f. Improve channel crossing for livestock and wildlife.	Yes or No	No
g. Preserve fishing stream habitat.	Miles	0
h. Create waterfowl breeding habitat.	Acres	0
i. Enhance waterfowl breeding habitat.	Acres	0
j. Improve critical winter habitat for big game animals.		
1. Antelope	Acres	0
2. Mule Deer	Acres	0
3. Elk	Acres	0
4. Moose	Acres	0
k. Reduce waterfowl habitat associated with cropland.	Ac. of cropland	101,700
4. Irreversible or irretrievable commitment of resources		
a. Commit rangeland and forest land to recreation areas.	Acres	161
b. Commit perennial stream to reservoir.	Miles	3
c. Commit Colorado River Compact water to various uses.	Acre-feet	29,900
d. Consume fossil fuels during construction.	Yes or No	Yes
C. SOCIAL WELL-BEING (Beneficial and adverse effects)		
1. Create temporary jobs during installation of structures and land treatment.	Jobs	504
2. Create permanent jobs.	Jobs	585
3. Create seasonal jobs.	Jobs	97
4. Improve ranch unit stability.	Yes or No	Yes
5. Improve recreation experience for visitors.	Yes or No	Yes
6. Utilize Colorado River Compact water in Wyoming.	Acre-feet	29,900
7. Reduce landowner rights along streams.	Acres	0
8. Improve overall hunting quality.	Yes or No	No
9. Increase hunting opportunities.	Yes or No	No
10. Improve fishing quality.	Yes or No	No
11. Increase fishing opportunities.	Yes or No	Yes
12. Discover, protect or enhance archeological resources.	Acres	0
13. Discover, protect or enhance fossil resources.	Acres	0
14. Discover, protect or enhance historical resources.	Sites	0
15. Harvest renewable wood fiber resources on commercial forest land	Yes or No	Yes
16. Increase human activities on water area and associated land.	Acres	735
17. Increase or improve accessibility to commercial forest land.	Yes or No	Yes
18. Decrease number of visitors at certain times, limit choice of areas and limit motor vehicle use.	Yes or No	No
19. Decrease livestock grazing on critical winter range for wildlife.	Acres	0
20. Reduce future opportunities to appropriate water for agriculture.	Yes or No	No
21. Reduce real estate taxes to landowners.	Yes or No	No
22. Reduce tax revenue to local governments.	Yes or No	No
23. Provide more flexibility for meeting Colorado River Compact water commitments.	Yes or No	No
24. Protect natural resources for future generations.	Yes or No	No

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective - Protect 800 miles of privately-owned stream corridors in visual classes 5, 4, and 3. Enhance 370 miles of stream in visual classes 2 and 1.

Plan Element - Enact local protective zoning with tax credits on 800 miles (38,800 acres) of stream corridor. Install land treatment measures such as proper grazing systems, fencing, and tree planting; and purchase scenic easements on 370 miles (17,900 acres) of stream corridor. (See Table V-9).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS

	REGION	REST OF NATION
1. Corridor delineation 1/ $240,000	19,900	0
2. Tax credits on 38,800 acres 2/ $1,940,000	77,600	0
3. Scenic easement purchase on 17,900 acres 1/ $447,500	17,900	
4. Land treatment on 17,900 acres 1/ $537,000	22,300	22,300
5. Technical assistance for land treatment $107,400	0	8,900
Subtotal	137,300	31,200
Total Adverse Effects		$ 168,500

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

Preservation and enhancement of 1,170 miles of stream corridor which include important habitats for fish, wildlife and plants.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Restrict future development on 56,700 acres.
2. Reduce landowner rights on 38,800 acres.
3. Maintain visual quality of landscape on 38,800 acres of stream corridor.
4. Improve or restore visual quality of landscape on 17,900 acres of stream corridor.
5. Create 15 temporary jobs during installation.
6. Reduce real estate taxes to landowners.
7. Reduce tax revenues to local governments.
8. Preserve resource base for future generations.

1/ Average annual cost amortized at 6 5/8 percent for 25 years.
2/ Average annual costs for tax credits.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective- Reduce concentrated use in local areas within nine wilderness management units of the Bridger Wilderness Area. 1/

Plan Element- Initiate an entry permit system, employ personnel to operate entrance stations, employ more wilderness patrol personnel, relocate trails, remove some cabins. and improve animal and human waste management.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS 2/

	REGION	REST OF NATION
1. Increase costs for administrative, operation, maintenance, replacement, and relocation.	0	95,000
Subtotal	0	95,000
Total Adverse Effects	$ 95,000	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Reduce areas of concentrated use by people and livestock.
2. Distribute people into areas previously under utilized.
3. Reduce trail erosion.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Improve quality of recreational experience.
2. Improve aesthetic quality of area.
3. Decrease number of visitors at certain times and limit choice of areas.
4. Create 2 permanent jobs.
5. Create 10 seasonal jobs.
6. Preserve resource base for future generations.

1/ Study objective to be accomplished by 1985.
2/ Annual costs.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective- Identify critical archeologic and fossil areas.

Plan Element- Accelerate the general reconnaissance of the basin for archeological resources on 344,000 acres and for paleontological resources on 3,578,500 acres.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS 1/

	REGION	REST OF NATION
1. Archeological recon. costs $1,376,000	57,000	57,000
2. Paleontological recon. costs $3,565,000	148,000	148,000
Subtotal	205,000	205,000
Total Adverse Effects	$ 410,000	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

Increase human activities on land involving archeological and fossil areas and access routes.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Identify unknown archeological and paleontological resources.
2. Provide data necessary to undertake preservation of significant discoveries for future generations.
3. Provide learning experiences using new discoveries.
4. Prevent destruction of most significant archeological and paleontological resources by activities such as mining, building of transportation corridors, construction of impoundments, and changed land use.
5. Create 99 temporary jobs during survey.

1/ Average annual costs amortized 25 years at 6 5/8 percent. Assumed that federal programs and various grants could pay for half or more of the total cost.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective- Preserve and improve 113 historic sites.

Plan Element- Install roads, signs, parking areas, and foot trails. Initiate scheduled operations, maintenance, police patrols, and necessary replacements. Sites by counties are: Carbon - 3, Fremont - 25, Sublette - 17, Sweetwater - 46, and Uinta - 22 (See Figure V-23).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS 1/

	REGION	REST OF NATION
1. Installation cost $2,463,000	$ 132,100	$ 132,100
2. Operation, Maintenance, and replacement $1,848,000	99,100	99,100
Subtotal	231,200	231,200
Total Adverse Effects	$ 462,400	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

Increase human activity on land involving historic sites and access routes.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Improve aesthetic quality of historic resources.
2. Improve availability of historic resources.
3. Decrease vandalism on new and existing facilities.
4. Preserve historic resources for future generations.
5. Create 86 temporary jobs during survey and restoration.

1/ Assumed 15 year life, amortized at 6 5/8 percent interest.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective- Reduce erosion on 1,026,300 acres of rangeland.

Plan Element- Accelerate installation of improved grazing management systems to reduce erosion. Practices and measures to reduce erosion include proper grazing use, fencing, water development, and grade stabilization structures. (See Figure V-6).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Acceleration of improved grazing management systems not evaluated in monetary terms. Benefits are assumed to be at least equal to costs.

ADVERSE EFFECTS 1/

	REGION	REST OF NATION
1. Installation costs for improved grazing management systems 2/ $7,184,000	154,000	616,100
2. Technical assistance 3/ $1,437,000	0	154,000
Subtotal	154,000	770,100
Total Adverse Effects	$ 924,100	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Reduce erosion on 1,026,300 acres of rangeland that have an erosion rate from 0.5 - 2.0 tons/acre/year to less that 0.5 tons/acre/year.
2. Improve the quality of terrestrial wildlife habitat on 1,026,300 acres.
3. Increase forage production by an estimated 20,500 AUMs by initiating grazing management.
4. Improve quality of coldwater fishing streams in rangeland areas.
5. Reduce sedimentation and phosphorus loading in reservoirs.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 240 temporary jobs during installation period.
2. Enhance visual quality on 1,026,300 acres.
3. Improve the quality of hunting on 1,026,300 acres.

1/ Assumed 15 year life, amortized at 6 5/8 percent interest.
2/ Cost per acres to treat estimated at $7.00 (from Yellowstone Level B Study); 60 percent acres est. public, 40 percent private ownership. Cost share on private assumed 50 percent. Land treatment assumed 15 year life and amortized at 6 5/8 percent.
3/ Cost for technical assistance based on 20 percent of total installation costs.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective - Reduce streambank erosion on 200 miles of stream.

Plan Element - Install streambank stabilization structures, grade stabilization structures, fences, adaptable trees and shrubs, and institute proper grazing use along 200 miles of stream. Streams needing treatment are: (1) Bitter Creek - 40 miles; (2) Salt Wells Creek - 30 miles; (3) Muddy Creek - southeast - 40 miles; (4) Little Muddy Creek - southwest - 80 miles; and (5) Little Snake River - 10 miles.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS 1/

	REGION	REST OF NATION
1. Installation costs of stabilization measures $372,000	19,900	19,900
2. Technical assistance $74,400	0	8,000
Subtotal	19,900	27,900
Total Adverse Effects	$ 47,800	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Improve water quality for fish forage and habitat on 200 miles of stream and their receiving waters.
2. Improve wildlife habitat along 200 miles of stream.
3. Reduce erosion and sedimentation.
4. Reduce nutrient loading in streams and reservoirs.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 9 temporary jobs during the installation period.
2. Improve visual quality along 200 miles of stream.
3. Improve channel crossing for livestock and wildlife.

1/ Assume 15 year life, amortized at 6 5/8 percent interest.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective - Provide minimum flows for a viable fishery on 188 miles of stream.

Plan Element - Enact a minimum streamflow law for fish and other aquatic resources. Store 36,000 ac.ft. of water in impoundments to annually augment flows for fish between September 1 through May 1 on following streams: Fontenelle Creek - 25 miles; Middle Piney Creek - 9 miles; LaBarge Creek - 30 miles; South Horse Creek - 6.5 miles; Tosi Creek - 14 miles. Augment streamflows on Hams Fork - 34 miles and Green River below Fontenelle Dam 69.5 miles by releasing water from existing reservoirs. 1/ 2/

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Benefits not evaluated in monetary terms. With the exception of Hams Fork and Green River, all other streams are not now subject to large storages of water. However, these streams are probably diverted in excess of minimum flows needed for fish. State or federal legislation is needed to allow appropriation of water for fish flows. Even with minimal flow laws, impoundments may be necessary to provide adequate water for fish and agriculture. To display the potentials, assumptions were made that all streams would be impounded where possible for this planning alternative. No costs were developed for instituting legislation and enforcement of laws.

ADVERSE EFFECTS 3/

ASSUMED STRUCTURAL SOLUTION

	REGION	REST OF NATION
1. Installation costs $10,323,000	685,000	0
2. Operation and maintenance costs (annual)	19,800	0
Subtotal	704,800	0 4/
Total Adverse Effects	$ 704,800	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Inundate 957 acres of riparian and upland wildlife habitat. 5/
2. Inundate 14 miles of stream.
3. Provide 957 surface acres of fish and waterfowl habitat.
4. Augment water flow during low flow periods on 69.5 miles of stream.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Provide stored water for agriculture, fish and wildlife, recreation and other uses.
2. Create 152 temporary jobs during installation.
3. Create 2 permanent jobs for maintenance.
4. Increase human activity on 1,157 acres of water and associated land area.
5. Consume fossil fuels during construction.
6. Reduce future opportunities to appropriate water for agriculture.

1/ Tosi Creek was not investigated for potential reservoir site.
2/ Refer to Watershed Investigation Report for more data on potential reservoir sites.
3/ Amortized 100 years @ 6 5/8 percent interest.
4/ Potential federal cost sharing not evaluated.
5/ Beneficial effects are very subjective since riparian and upland wildlife are replaced by waterfowl and fish habitat.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective- Maintain quality on 1,460 miles of very good to premium classified fishing streams.

Plan Element- Accelerate landowner cooperation program to further protect and rehabilitate fishing streams. Enact a stream protection law in Wyoming. (See Figure V-21).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS 1/

	REGION	REST OF NATION
1. Stream delineation and protection $438,000	36,300	0
Subtotal	36,300	0
Total Adverse Effects	$ 36,300 2/	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Preserve 1,460 miles of stream habitats for fish, benthic organisms, and aquatic wildlife and plants.
2. Reduce sediment and erosion on 1,460 miles of stream.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Reduce landowner rights on 1,460 miles of stream.
2. Maintain a productive sport fishery on 1,460 miles of stream.
3. Maintain visual quality on 1,460 miles of stream.
4. Create 1 temporary job during delineation.
5. Create 2 permanent jobs for enforcement.
6. Preserve resource base for future generations.

1/ Assume 25 year life, amortized at 6 5/8
2/ Costs were not developed for accelerating landowner cooperation program.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective - Enhance and create wetlands for waterfowl habitat.

Plan Element - Install habitat improvement measures on 4,800 acres of wetland and create 7,800 acres of wetland (see note below).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Beneficial effects of wetland habitat improvement measures were not evaluated in monetary terms.

NOTE: Install 45 goose nesting structures in upper Fontenelle Reservoir, 70 structures along 7 miles of Green River below Highway I-80, and 250 structures along the Big Sandy River. Install 50 islands in wetlands on the Eden-Farson irrigation project area and 50 islands in intermittent lakes in the Chain Lakes area. Clear brush for nesting sites on 86 islands (0.25 acre on each island) in the Green River from Fontenelle Reservoir to confluence of New Fork River. Create 7,800 acres of wetlands by diverting water from Big Sandy Reservoir to Sublette Flats. Assumption is made that water for this purpose is made available as a result of improved irrigation efficiency in the Eden-Farson area.

ADVERSE EFFECTS

	REGION	REST OF NATION
1. Installation of nesting structures $10,000 1/	500	500
2. Construction of islands 1/ $20,000	1,000	1,100
3. Brush clearing on islands 1/ $5,000	300	300
4. Annual maintenance for #1,2,3	900	900
5. Installation of water delivery system for Sublette Flats 2/ $474,000	16,400	16,400
6. Annual operation and main for #5 (does not include waterfowl mgt.)	9,500	9,500
7. Annual water costs	20,000	20,000
Subtotal	48,700	48,700
Total Adverse Effects	$ 97,400	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Create 7,800 acres of wetlands for waterfowl and wildlife.
2. Enhance 4,800 acres of existing wetlands for waterfowl and wildlife.
3. Change 5,000 acres of sagebrush - grassland and 2,800 acres of greasewood - saline flats to permanent wetland.
4. Divert water from Big Sandy River above the reservoir which may alter streamflow regime. 3/ 4/
5. Increase number of nesting waterfowl in basin.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Create 10 temporary jobs during installation period.
2. Create 1 permanent job for operation of structures.
3. Increase hunting and sightseeing visitor days on 7,800 acres.
4. Change 20,000 acre-feet of agricultural water to a waterfowl refuge use.

1/ Federal and state programs exist which could pay 50 to 100 percent of total costs; assumed 50 percent federal cost share; assumed 15 year life and amortized at 6 5/8 percent.
2/ Assumed 50 year life, amortized at 6 5/8 percent.
3/ Diversion could be made below the Eden-Farson area which would utilize saline water at a higher development cost.
4/ Detailed studies would be needed to determine effects on Green River and ground water salinity.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE B-ENVIRONMENTAL QUALITY (EQ)-YEAR 2000

Specific Study Objective- Enhance and protect critical winter habitat for selected resident wildlife species.

Plan Element- Accelerate installation of habitat improvement practices on critical winter range (see note below). Habitat types to improve are: antelope - 501,700 acres; mule deer - 510,000 acres; elk - 171,300 acres and moose - 73,500 acres. 1/(See Figures V-13, 14, 15, and 16).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

NOTE: Habitat improvement practices: restrict big game and livestock use of perennial livestock waters; promote greater composition of succulent forbs on summer range; maintain and enhance shrub forage, remove competition from wild horses; protect from development such as industry, mining, new cropland, reservoirs and fences; control off-road vehicle use; remove net wire fences along checkerboard land; decrease domestic sheep use; stimulate new growth of aspen stands; plant shelter-belts or install snow fences on some slopes to trap snow; protect streambank vegetation; modify height of fences; safeguard conifer timber stands on steep slopes; and implement and improve livestock grazing management systems to provide adequate forage for wintering wildlife.

ADVERSE EFFECTS 2/

	REGION	REST OF NATION
1. Installation of habitat improvement practices on 1,256,500 acres $6,282,500	40,400 3/	633,100 4/
2. Technical assistance $75,400 5/	0	8,100
Subtotal	40,400	641,200
Total Adverse Effects	$ 681,600	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Improve and protect critical winter habitat for big game on 1,256,500 acres.
2. Decrease winter mortality losses of antelope, mule deer, elk, and moose.
3. Improve habitat for several species of nongame birds and mammals on 1,256,500 acres.
4. Improve range condition and riparian habitat on critical winter range.
5. Reduce soil erosion on critical winter range.
6. Decrease perennial water sources on critical winter range.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 126 temporary jobs during installation of improvements.
2. Improve hunting by decreasing winter mortality losses.
3. Restrict use of motorized vehicles on public land.
4. Decrease livestock grazing on critical winter range.

1/ Acreages are estimates. Onsite inventories will be necessary prior to implementing specific enhancement programs.
2/ Assumed 15 year life, amortized at 6 5/8 percent interest.
3/ Costs estimated for private and State land.
4/ Costs estimated for Federal land under BLM and FS control.
5/ Technical assistance for private and State land.

Table VIII-5 Summary of planning alternative B effects for year 2000, Green River Basin, Wyoming

Accounts	Unit	Plan B (EQ)
A. ECONOMIC DEVELOPMENT		
1. Plan elements evaluated for benefits and costs		
a. Beneficial effects	Av. Ann. $	--
b. Adverse effects	Av. Ann. $	--
c. Net beneficial effects	Av. Ann. $	--
2. Plan elements evaluated for costs only		
a. Beneficial effects - not evaluated in monetary terms, benefits assumed at least equal to costs	--	--
b. Adverse effects	Av. Ann. $	3,627,900
B. ENVIRONMENTAL QUALITY (Beneficial and adverse effects)		
1. Areas of natural beauty		
a. Change rangeland and forest land to recreation facilities.	Acres	0
b. Improve recreation site aesthetics.	Yes or No	No
c. Preserve and enhance scenic stream corridors.	Miles	1,660
d. Decrease visual quality by increasing activity on commercial forest land.	Yes or No	No
e. Improve visual quality on rangeland.	Acres	1,026,300
2. Quality consideration of water, land, and air resources.		
a. Improve water quality by decreasing TDS (amount undetermined), and nutrients entering the Green River and reservoirs.	Yes or No	No
b. Increase forage production.	AUMs	20,500
c. Improve irrigation efficiency.	Acres	0
d. Reduce soil erosion on rangeland, roads and trails.	Acres	1,026,300
e. Increase human activity on recreation areas.	Yes or No	No
f. Increase human activity on new accessible streams.	Miles	0
g. Reduce erosion and sedimentation on streams.	Miles	200
h. Increase erosion and sediment during construction and logging.	Yes or No	Yes
i. Reduce Green River water discharge to Colorado River.	Yes or No	No
j. Increase human activities on commercial forest land.	Yes or No	No
k. Improve fish management on streams.	Yes or No	Yes
l. Decrease forest fire, disease, and insect hazards.	Yes or No	No
m. Harvest timber in wilderness study and roadless areas.	Yes or No	No
n. Reduce use concentration in wilderness area from people and livestock.	Management unit	9
3. Biological resources and selected ecosystems		
a. Increase open water wetlands.	Acres	957
b. Inundate perennial streams.	Miles	14
c. Inundate terrestrial wildlife habitat.	Acres	5,957
d. Decrease phreatophytes and associated wildlife along streams.	Yes or No	No
e. Reduce stream flow fluctuations.	Yes or No	Yes
f. Improve channel crossing for livestock and wildlife.	Yes or No	Yes
g. Preserve fishing stream habitat.	Miles	1,460
h. Create waterfowl breeding habitat.	Acres	7,800
i. Enhance waterfowl breeding habitat.	Acres	4,800
j. Improve critical winter habitat for big game animals.		
1. Antelope	Acres	501,700
2. Mule Deer	Acres	510,000
3. Elk	Acres	171,300
4. Moose	Acres	73,500
k. Reduce waterfowl habitat associated with cropland.	Ac. of cropland	0
4. Irreversible or irretrievable commitment of resources		
a. Commit rangeland and forest land to recreation areas.	Acres	0
b. Commit perennial stream to reservoir.	Miles	14
c. Commit Colorado River Compact water to various uses.	Acre-feet	20,000
d. Consume fossil fuels during construction.	Yes or No	Yes
C. SOCIAL WELL-BEING (Beneficial and adverse effects)		
1. Create temporary jobs during installation of structures and land treatment.	Jobs	738
2. Create permanent jobs.	Jobs	7
3. Create seasonal jobs.	Jobs	10
4. Improve ranch unit stability.	Yes or No	No
5. Improve recreation experience for visitors.	Yes or No	No
6. Utilize Colorado River Compact water in Wyoming.	Acre-feet	20,000
7. Reduce landowner rights along streams.	Acres	91,800
8. Improve overall hunting quality.	Yes or No	Yes
9. Increase hunting opportunities.	Yes or No	Yes
10. Improve fishing quality.	Yes or No	Yes
11. Increase fishing opportunities.	Yes or No	No
12. Discover, protect or enhance archeological resources.	Acres	344,000
13. Discover, protect or enhance fossil resources.	Acres	3,578,500
14. Discover, protect or enhance historical resources.	Sites	113
15. Harvest renewable wood fiber resources on commercial forest land	Yes or No	No
16. Increase human activities on water area and associated land.	Acres	9,100
17. Increase or improve accessibility to commercial forest land.	Yes or No	No
18. Decrease number of visitors at certain times, limit choice of areas and limit motor vehicle use.	Yes or No	Yes
19. Decrease livestock grazing on critical winter range for wildlife.	Acres	1,256,500
20. Reduce future opportunities to appropriate water for agriculture.	Yes or No	Yes
21. Reduce real estate taxes to landowners.	Yes or No	Yes
22. Reduce tax revenue to local governments.	Yes or No	Yes
23. Provide more flexibility for meeting Colorado River Compact water commitments.	Yes or No	No
24. Protect natural resources for future generations.	Yes or No	Yes

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C-YEAR 2000

Specific Study Objective - Improve irrigation water supplies for late season use on 4,000 acres. (Part 1 of 2). This part displays projects that are feasible using direct benefits alone. External benefits are also shown.

Plan Element - Install two irrigation storage structures and initiate irrigation water management systems on 4,000 acres. Storage structures are on Fall Creek (Burnt Lake) and Silver and Spring Creeks.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

		DIRECT 2/	EXTERNAL 3/
1.	Increase winter forage production by 15,600 AUMs	60,300	71,200
2.	Nonagricultural benefits 4/	452,500	534,000
	Subtotal	512,800	605,200
	Total Beneficial Effects	$1,118,000	

ADVERSE EFFECTS (Average Annual $) 1/

		REGION	REST OF NATION
1.	Storage structure construction costs $5,929,000	196,700	196,700
2.	Land and water rights $664,000	22,000	0
3.	Operation, maintenance, replacement	12,100	0
4.	Administration $208,000	2,800	11,000
5.	Engineering Services $320,000	0	21,200
6.	Relocation costs $50,000	1,700	1,700
	Subtotal	235,300	230,600
	Total Adverse Effects	$ 465,900	
	Net Beneficial Effects 5/	+ $ 652,100	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Increase lake habitat for waterfowl, aquatic mammals, and fish by 635 surface acres.
2. Destroy 3 miles of perennial stream through inundation.
3. Destroy 635 acres of terrestrial wildlife habitat through inundation.
4. Reduce streamflow fluctuations.
5. Reduce streamflow discharges from the Green River to the Colorado River.
6. Increase sedimentation during construction.
7. Reduce waterfowl habitat associated with 4,000 acres of cropland by improving water delivery and application systems.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 118 temporary jobs during installation period.
2. Create 1 permanent job for maintenance.
3. Improve economic stability of ranch units.
4. Increase human activity on 735 acres of land and water.
5. Utilize 29,900 acre-feet of available Colorado River Compact water(2,050 acre-feet is for agriculture).
6. Provide local waterfowl hunting on reservoirs and adjacent land.
7. Consume fossil fuels during construction.
8. Improve irrigation efficiency on 4,000 acres.

1/ Amortized 100 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Nonagricultural benefits assume that industry, municipalities, recreation facilities and fish and wildlife developments will buy remaining available water at cost.
5/ Water shortages on Fall Creek can be satisfied with a smaller project that has agricultural benefits which exceed costs. Average annual installation costs to satisfy only irrigation shortages would be $17,800 (includes OM&R) and agricultural benefits would be $28,600.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C-YEAR 2000

Specific Study Objective- Improve irrigation water supplies for late season use on 54,100 acres (Part 2 of 2). This part displays projects that are feasible only by using direct and external benefits.

Plan Element- Install six irrigation storage structures and initiate irrigation water management systems on 44,200 acres. Storage structures are on Horse Creek (2 sites), North Piney Creek (1 site), and Middle and South Piney Creeks (3 sites). Accelerate land treatment to improve irrigation efficiency on the remaining 9,900 acres having water shortages.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

	DIRECT[2/]	EXTERNAL[3/]
1. Increase winter forage production by 172,400 AUMs	547,200	645,700
2. Nonagricultural benefits[4/]	413,800	289,700
Subtotal	961,000	935,400
Total Beneficial Effects	$ 1,896,400	

NOTE: Benefits of accelerated land treatment program for the 9,900 acres were not evaluated in monetary terms. Total treatment installation costs are $1,485,000 ($159,200 average annual at 6 5/8 percent for 15 years). Technical assistance costs are $297,000 ($31,800 average annual).

ADVERSE EFFECTS (Average Annual $)[1/]

	REGION	REST OF NATION
1. Storage structure construction costs $22,873,000	1,517,600	0
2. Land and water rights $53,000	3,500	0
3. Operation, maintenance, replacement	34,000	0
4. Administration $576,000	38,200	0
5. Engineering services $1,009,000	66,900	0
6. Relocation costs $10,000	700	0
Subtotal	1,660,900	0
Total Adverse Effects	$ 1,660,900	
Net Beneficial Effects	+ $ 235,500	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Increase lake habitat for waterfowl, aquatic mammals, and fish by 1,275 surface acres.
2. Destroy 8 miles of perennial stream through inundation.
3. Destroy 1,275 acres of terrestrial wildlife habitat through inundation.
4. Reduce streamflow fluctuations.
5. Reduce streamflow discharges from the Green River to the Colorado River.
6. Increase sedimentation during construction.
7. Reduce waterfowl habitat associated with 54,100 acres of cropland by improving water delivery and application systems.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 457 temporary jobs during installation period.
2. Create 2 permanent jobs for maintenance.
3. Improve economic stability of ranch units.
4. Increase human activity on 1,475 acres of land and water.
5. Utilize 29,600 acre-feet of available Colorado River Compact water (17,500 acre feet is for agriculture).
6. Provide local waterfowl hunting on reservoirs and adjacent land.
7. Consume fossil fuels during construction.
8. Improve irrigation efficiency on 54,100 acres.

1/ Amortized 100 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Nonagricultural benefits assume that industry, municipalities, recreation facilities and fish and wildlife developments will buy remaining available water at cost.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C-YEAR 2000

Specific Study Objective- Increase the utilization of fuelwood and small wood products.

Plan Element- Encourage additional timber sale permits on Forest Service land to increase annual harvest for fuelwood to 2,170 cords; for the number of posts to 1,650; and for the number of poles to 8,350.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

	DIRECT2/	EXTERNAL3/
Benefits resulting from the sale of fuelwood, posts, and poles.	110,200	77,100
Subtotal	110,200	77,100
Total Beneficial Effects	$ 187,300	

ADVERSE EFFECTS (Average Annual $)1/

		REGION	REST OF NATION
Costs for increased harvest for logging and hauling.4/	fuelwood	54,300	0
	posts	1,800	0
	poles	13,700	0
Subtotal		69,800	0
Total Adverse Effects		$ 69,800	
Net Beneficial Effects		+ $ 117,500	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Increase human activity on commercial forest land.
2. Decrease fire, disease, and insect hazards.

** Other environmental effects are included in display for roundwood harvest.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 2 permanent jobs.
2. Alter visual quality on commercial forest land over 20 year period.

1/ Average annual costs for harvest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Forest Service administrative costs not included.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE C - YEAR 2000

Specific Study Objective - Increase roundwood production by 5.1 MMcu.ft. and maintain 1970 harvest level of 7.4 MMcu.ft. (Note - Annual harvest estimated to be 3.0 MMcu.ft. for year 2000 without project action). (1970 level is 1969 - 73 average).

Plan Element - Install commercial forest land treatment measures on 75,000 acres. Practices include site preparation and planting on 24,000 acres and thinning on 51,000 acres. Increase timber sale offerings on Forest Service land to harvest annually 7.4 MMcu.ft. of roundwood from portions of commercial forest land (542,000 acres).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

	DIRECT 2/	EXTERNAL 3/
Benefits accruing to roundwood sales at the mill.	4,315,800	3,021,000
Subtotal	4,315,800	3,021,000
Total Beneficial Effects	$ 7,336,800	

ADVERSE EFFECTS (Average Annual $) 1/

	REGION	REST OF NATION
1. Cost of forest land treatment $4,125,000	57,900	148,500
2. Costs for harvest include stumpage, logging and hauling to mill. 4/ 5/	3,785,800	0
Subtotal	3,843,600	148,500
Total Adverse Effects	$ 3,992,000	
Net Beneficial Effects	+ $ 3,344,800	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Alter wildlife habitat on portions of commercial forest over 20 year period
2. Increase soil erosion during logging operations.
3. Increase human activity on commercial forest over 20 year period.
4. Harvest roundwood on present wilderness study and roadless areas.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Re-establish 1970 level of forest-related employment by creating 100 permanent jobs.
2. Increase and improve accessibility to commercial forest over 20 year period.
3. Alter visual quality on an additional 121,400 acres of commercial forest over 20 year period.
4. Harvest a renewable resource.
5. Consume nonrenewable fossil fuels during harvest and manufacture of roundwood.
6. Increase hunting days by improving access and increasing wildlife numbers during re-establishment of timber stands.

1/ Average annual costs for treatment and harvest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Forest Service administrative costs not included.
5/ Timber harvest in Green River Basin is highly constrained by wildlife and aesthetic considerations and roadless areas.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C-YEAR 2000

Specific Study Objective- Reduce erosion on 513,000 acres of rangeland.

Plan Element- Install grazing management systems on 513,000 acres to reduce erosion. Practices to reduce erosion include grazing management, fencing, water developments, and grade stabilization structures. (See Figure V-6).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

DIRECT[2/]	EXTERNAL[3/]

NOTE: Accelerated land treatment program not evaluated in monetary terms. Benefits are assumed at least equal to costs.

ADVERSE EFFECTS (Average Annual $)[1/]

	REGION	REST OF NATION
1. Installation costs for land treatment practices. $3,592,000	192,500	192,500
2. Technical assistance $718,400	0	77,000
Subtotal	192,500	269,500
Total Adverse Effects	$ 462,000	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Reduce erosion from 0.5 tons/acre/year and higher rate to less than 0.5 tons/acre/year on 513,000 acres of rangeland.
2. Improve the quality of terrestrial wildlife habitat on 513,000 acres.
3. Increase forage production by an estimated 10,300 AUMs by initiating grazing management.
4. Improve quality of coldwater fishing streams in rangeland areas.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 119 temporary jobs during installation period.
2. Enhance visual quality on 513,000 acres of rangeland.
3. Improve the quality of hunting on 513,000 acres.
4. Increase forage production and availability for livestock on 513,000 acres.

1/ Amortized 15 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE C - YEAR 2000

Specific Study Objective - Reduce streambank erosion on 100 miles of stream.

Plan Element - Install streambank stabilization structures, grade stabilization structures, fences, adaptable trees and shrubs, and institute proper grazing use along 100 miles of stream. (See Chapter III for locations of streambank erosion).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

DIRECT[2/] EXTERNAL[3/]

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS (Average Annual $)[1/]

	REGION	REST OF NATION
1. Installation cost of stabilization measures $186,000	10,000	10,000
2. Technical assistance $37,200	0	4,000
Subtotal	10,000	14,000
Total Adverse Effects	$ 24,000	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Improve water quality for fish habitat on 100 miles of stream and their receiving waters.
2. Improve wildlife habitat along 100 miles of stream.
3. Reduce erosion and sedimentation.
4. Reduce nutrient load in streams and reservoirs.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Create 5 temporary jobs during the installation period.
2. Improve visual quality along 100 miles of stream
3. Improve channel crossing for livestock and wildlife.

1/ Amortized 15 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C - YEAR 2000

Specific Study Objective - Improve management of the present recreation activity opportunities and recreation facility maintenance program on all developed sites, dispersed areas, and recreation trails.

Plan Element - Increase funding by $642,100 annually. Detailed funding increases as follows:
Developed areas: Maintenance - $151,700 and Operation - $276,700
Dispersed areas: Maintenance - $ 16,700 and Operation - $ 62,500
Recreation trails: Maintenance - $134,500

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

	DIRECT 2/	EXTERNAL 3/
1. Increase in quality of recreation visitor day 4/	785,000	785,000
Subtotal	785,000	785,000
Total Beneficial Effects	$ 1,570,000	

ADVERSE EFFECTS (Average Annual $) 1/

	REGION	REST OF NATION
1. Operation of recreation activities and facilities	142,500	196,700
2. Maintenance of recreation facilities	127,200	175,700
Subtotal	296,700	372,400
Total Adverse Effects	$ 642,100	
Net Beneficial Effects	+ $ 927,900	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Reduce erosion on roads and trails.
2. Improve recreation activities in localized areas.
3. Improve aesthetic quality of recreation sites.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 22 permanent jobs annually.
2. Create 60 seasonal jobs.
3. Improve recreation experience for visitors.
4. Consume fossil fuels during maintenance.
5. Update recreation facilities.

1/ Average annual costs.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accuring to various sectors of the economy.
4/ Benefits calculated by estimating the increase in value of a recreation visitor day from $.75 to $1.50 for 1,046,500 RVDs.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C - YEAR 2000

Specific Study Objective - Increase recreation facilities.

Plan Element - Install new recreation facilities as follows: [redacted] boat launching sites, 79 picnic grounds (3 units each), 7 campgrounds (25 units each), and acquire access to 562 miles of fishing stream.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

	DIRECT 2/	EXTERNAL 3/
1. Provide 243,300 visitor days. 4/	1,367,800	1,367,800
Subtotal	1,367,800	1,367,800
Total Beneficial Effects	$ 2,735,600	

ADVERSE EFFECTS (Average Annual $) 1/

	REGION	REST OF NATION
1. Installation costs $5,054,700	270,900	270,900
2. Land rights $8,470,200	454,000	454,000
3. Operation and maintenance	146,300	146,300
4. Administration	66,600	66,600
Subtotal	937,800	937,800
Total Adverse Effects	$1,875,600	
Net Beneficial Effects	+ $ 860,000	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Change 245 acres of rangeland or forest land to recreation facilities.
2. Increase human activity on land adjacent to new facilities.
3. Increase human activity on 562 miles of stream serviced by new access sites.
4. Improve fishery management on 562 miles of stream serviced by new access sites.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 101 temporary jobs during installation period.
2. Create 44 seasonal jobs.
3. Consume fossil fuels for construction.

1/ Amortized 15 years [redacted] 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Average annual benefits based on $3.00/RVD for camping and picniking with water setting and $9.00/RVD for streat access and reservoir boating.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE C-YEAR 2000

Specific Study Objective - Protect 800 miles of privately-owned stream corridors in visual classes 5, 4 and 3.

Plan Element - Enact local protective zoning with tax credits on 800 miles (38,800 acres) of stream corridor. (See Table V-9).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $) — DIRECT 2/ EXTERNAL 3/

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS (Average Annual $)1/

	REGION	REST OF NATION
1. Corridor delineation and protection $240,000	19,900	0
2. Tax credits on 38,800 acres. $1,940,000	77,600	0
Subtotal	97,500	0
Total Adverse Effects	$ 97,500	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

Preservation and enhancement of 800 miles of stream corridor which include important habitats for fish, wildlife, and plants.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Restrict future development on 38,800 acres.
2. Reduce landowner rights on 38,800 acres.
3. Maintain visual quality of landscape on 38,800 acres.
4. Create 5 temporary jobs during stream corridor delineation.
5. Reduce real estate taxes to landowners.
6. Reduce tax revenues to local governments.

1/ Amortized 25 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C - YEAR 2000

Specific Study Objective - Reduce concentrated use in local areas within nine wilderness management units of the Bridger Wilderness Area.1/

Plan Element - Initiate a use permit system, employ personnel to operate entrance stations, employ more wilderness patrol personnel, relocate trails, remove some cabins, and improve animal and human waste management.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

DIRECT 2/ EXTERNAL 3/

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS (Average Annual $)4/

	REGION	REST OF NATION
Increase costs for administrative, operation, maintenance, replacement, and relocation.	0	95,000
Subtotal	0	95,000
Total Adverse Effects	$ 95,000	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Reduce areas of concentrated use by people and livestock.
2. Distribute people into areas previously under utilized.
3. Reduce trail erosion.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Improve quality of recreational experience.
2. Improve aesthetic quality of area.
3. Decrease number of visitors at certain times and limit choice of areas.
4. Create 2 permanent jobs.
5. Create 10 seasonal jobs.

1/ Study objective to be completed by 1985.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Average annual cost.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE C-YEAR 2000

Specific Study Objective- Identify critical archeologic and fossil areas.

Plan Element- Accelerate the general reconnaissance of the basin for archeological resources on 172,000 acres and for paleontological resources on 1,789,000 acres.

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

DIRECT 2/ EXTERNAL 3/

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS (Average Annual $)1/

	REGION	REST OF NATION
1. Archeological recon. costs $688,000	28,500	28,500
2. Paleontological recon. costs $1,782,500	73,900	73,900
Subtotal	102,400	102,400
Total Adverse Effects	$ 204,800	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

Increase human activities on land involving archeological and fossil areas and access routes.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Identify unknown archeological and paleontological resources on 1,961,000 acres.
2. Provide data necessary to undertake preservation of significant discoveries.
3. Provide learning experiences using new discoveries.
4. Prevent destruction of most significant archeological and paleontological resources by activities such as mining, building of transportation corridors, construction of impoundments, and changed land use.
5. Create 49 temporary jobs during survey.

1/ Amortized 15 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C - YEAR 2000

Specific Study Objective - Preserve and improve 90 historic sites.

Plan Element - Install roads, signs, parking areas, and foot trails. Initiate scheduled operations, maintenance, police patrols, and necessary replacements. Sites by counties are: Carbon - 3, Fremont - 25, Sublette - 17, Sweetwater - 23, and Uinta - 22. (See Figure V-23).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

DIRECT 2/ EXTERNAL 3/

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS (Average Annual $) 1/

	REGION	REST OF NATION
1. Installation cost $1,962,000	79,200	79,200
2. Operation, maintenance, and replacement $1,478,400	79,300	79,300
Subtotal	158,500	158,500
Total Adverse Effects	$ 317,000	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

Increase human activity on land involving historic sites and access routes.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Improve aesthetic quality of historic resources.
2. Improve availability of historic resources.
3. Decrease vandalism on new and existing facilities.
4. Preserve historic resources.
5. Create 68 temporary jobs during survey and restoration.

1/ Amortized 15 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE C - YEAR 2000

Specific Study Objective - Provide minimum flows for a viable fishery on 174 miles of stream.1/

Plan Element - Enact a minimum streamflow law for fish and other aquatic resources. Law should allow appropriation of water for fish (nonconsumptive use) in existing reservoirs if supply is available. (See Chapter III for locations).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

DIRECT 2/ EXTERNAL 3/

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS (Average Annual $)4/

	REGION	REST OF NATION
Cost for enforcement of minimum flow law.5/	30,000	0
Subtotal	30,000	0
Total Adverse Effects	$ 30,000	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Guarantee minimum streamflow for fish on 174 miles of stream.
2. Increase fish productivity on 174 miles of stream.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Provide undetermined number of jobs for enacting legislation and enforcing minimum streamflow law.
2. Reduce future opportunities to appropriate water for agriculture.
3. Increase recreational use of streams.
4. Create 2 permanent jobs for enforcement of law.

1/ 14 miles of Tosi Creek - minimum flow law only would not solve problem, storage would be needed.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Average annual costs.
5/ Costs for legislation and non-consumptive use of water were not evaluated.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE C - YEAR 2000

Specific Study Objective - Maintain quality on 1,460 miles of very good to premium classified fishing streams.

Plan Element - Accelerate landowner cooperative program to further protect and rehabilitate fishing streams. Enact and enforce a stream protection law in Wyoming. (See Figure V-21).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

DIRECT 2/ EXTERNAL 3/

NOTE: Benefits not evaluated in monetary terms. Benefits assumed at least equal to costs.

ADVERSE EFFECTS (Average Annual $) 1/

	REGION	REST OF NATION
Stream delineation and protection $438,000	36,300	0
Subtotal	36,300	0
Total Adverse Effects	$ 36,300 4/	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

Preserve 1,460 miles of stream habitats for fish, benthic organisms, and aquatic wildlife and plants.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Reduce landowner rights on 1,460 miles of stream.
2. Maintain a productive sport fishery on 1,460 miles of stream.
3. Maintain visual quality on 1,460 miles of stream.
4. Create 1 temporary job during delineation.
5. Create 2 permanent jobs for enforcement.

1/ Amortized 25 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Costs were not developed for accelerating landowner cooperative program.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C-YEAR 2000

Specific Study Objective - Enhance and create wetlands for waterfowl habitat.

Plan Element - Install habitat improvement measures on 4,800 acres of wetland and create 7,800 acres of wetland. (See note below).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

DIRECT 2/ EXTERNAL 3/

NOTE: Beneficial effects of wetland habitat improvement measures were not evaluated in monetary terms.

NOTE: Install 45 goose nesting structures in upper Fontenelle reservoir, 70 structures along 7 miles of Green River below highway I-80, and 250 structures along the Big Sandy River. Install 50 islands in wetlands on the Eden-Farson irrigation project area and 50 islands in intermittent lakes in the Chain Lakes area. Clear brush for nesting sites on 86 islands (0.25 acre on each island) in the Green River from Fontenelle Reservoir to confluence of New Fork River. Create 7,800 acres of wetlands by diverting water from Big Sandy Reservoir to Sublette Flats. Assumption is made that water for this purpose is made available as a result of improved irrigation efficiency in the Eden-Farson area.

ADVERSE EFFECTS (Average Annual $)1/

		REGION	REST OF NATION
1.	Installation of nesting structures $10,0004/	500	500
2.	Construction of islands4/ $20,000	1,100	1,100
3.	Brush clearing on islands4/ $5,000	300	300
4.	Annual maintenance for #1,2,3	900	900
5.	Installation of water delivery system for Sublette Flats5/	16,400	16,400
6.	Annual operation and main. for #5 (does not include waterfowl mgt.	9,500	9,500
7.	Annual water costs	20,000	20,000
	Subtotal	48,700	48,700
	Total Adverse Effects	$97,400	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 7,800 acres of wetlands for waterfowl and wildlife.
2. Enhance 4,800 acres of existing wetlands for waterfowl and wildlife.
3. Change 5,000 acres of sagebrush-grassland and 2,800 acres of greasewood-saline flats to permanent wetland.
4. Divert water from Big Sandy River above the reservoir which may alter streamflow regime.6/ 7/
5. Increase number of nesting waterfowl in basin.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 10 temporary jobs during installation period.
2. Create 1 permanent job for operation of structures.
3. Increase hunting and sightseeing visitor days on 7,800 acres.
4. Change 20,000 acre-feet of agricultural water to a waterfowl refuge use.

1/ Amortized 15 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Federal and state programs exist which could pay 50 to 100 percent of total costs; assumed 50 percent federal cost share; assumed 15 year life, amortized at 6 5/8 percent.
5/ Assumed 50 year life, amortized at 6 5/8 percent.
6/ Diversion could be made below Eden-Farson area which would utilize saline water but at a higher development cost.
7/ Detailed studies would be needed to determine effects on Green River and groundwater salinity.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES

Green River Basin, Wyoming

ALTERNATIVE C-YEAR 2000

Specific Study Objective - Enhance and protect critical winter habitat for selected resident wildlife species.

Plan Element - Accelerate installation and initiation of habitat improvement practices on critical winter range (see note below). Habitat types to improve are: antelope - 251,000 acres; mule deer - 255,000 acres; elk - 171,300 acres; and moose - 73,500 acres.1/ (See Figures V-13, 14, 15 and 16).

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

DIRECT 2/ EXTERNAL 3/

NOTE: Not evaluated in monetary terms. Benefits assumed at least equal to costs.

NOTE: Habitat improvement practices: restrict big game and livestock use of perennial livestock waters; promote greater composition of succulent forbs on summer range; maintain and enhance shrub forage; remove competition from wild horses; protect from development such as industry, mining, new cropland; reservoirs and fences; control off-road vehicle use; remove net wire fences along checkerboard land; decrease domestic sheep use; stimulate new growth of aspen stands; plant shelterbelts or install snow fences on some slopes to trap snow; protect streambank vegetation; modify height of fences; safeguard conifer timber stands on steep slopes; and implement and improve livestock grazing management systems to provide adequate forage for wintering wildlife.

ADVERSE EFFECTS (Average Annual $) 4/

	REGION	REST OF NATION
1. Installation of habitat improvement practices on 750,800 acres $3,754,000	40,200 5/	402,400 6/
2. Technical assistance $75,100	0	8,100 7/
Subtotal	40,200	410,500
Total Adverse Effects	$450,700	

ENVIRONMENTAL QUALITY ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Improve and protect critical winter habitat for big game on 750,800 acres.
2. Decrease winter mortality losses of antelope, mule deer, elk, and moose.
3. Improve habitat for several species of nongame birds and mammals on 750,800 acres.
4. Improve range condition and riparian habitat on critical winter range.
5. Reduce soil erosion on critical winter range.
6. Decrease perennial water sources on critical winter range.

SOCIAL WELL-BEING ACCOUNT

BENEFICIAL AND ADVERSE EFFECTS

1. Create 76 temporary jobs during installation of improvements.
2. Improve hunting by decreasing winter mortality losses.
3. Restrict use of motorized vehicles on public land.
4. Decrease livestock grazing on critical winter range.

1/ Acreages are estimates. On site inventories will be necessary prior to implementing specific enhancement programs.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ Amortized 15 years @ 6 5/8 percent interest.
5/ Costs estimated for private and State land.
6/ Costs estimated for Federal land under BLM and FS control.
7/ Technical assistance for private and State land.

LAND AND WATER RESOURCE DEVELOPMENT ALTERNATIVES
Green River Basin, Wyoming

ALTERNATIVE C-YEAR 2000

Specific Study Objective- Utilize 188,200 acre-feet of Colorado River Compact water in basin.

Plan Element- Previous plan elements to improve late season irrigation water supplies and create wetlands for waterfowl use 78,200 acre-feet of water. Remaining Compact water available for storage and use is 110,000 acre-feet. Plan elements displayed here are to construct dams with sufficient active storage capacity to store 110,000 acre-feet at the lowest possible costs. Storage sites are on Pine Creek (Fremont Lake) and Boulder Creek (Boulder Lake).***

ECONOMIC DEVELOPMENT ACCOUNT

BENEFICIAL EFFECTS (Average Annual $)

	DIRECT 2/	EXTERNAL 3/
Nonagricultural benefits - assumed that nonagricultural uses would buy water for cost and receive direct benefits at least equal to costs. Cost per acre-foot are $1.80 on Pine Creek (total 73,600 acre-feet); and $2.15 on Boulder Creek (total 57,100 acre-feet). 4/ 5/	255,500	178,900
Subtotal	255,500	178,900
Total Beneficial Effects	$ 434,400	

ADVERSE EFFECTS (Average Annual $) 1/

	REGION	REST OF NATION
1. Storage structure costs $2,515,000	166,900	0
2. Land and water rights $120,000	8,000	0
3. Operation, maintenance, replacement	7,000	0
4. Administration $121,000	8,000	0
5. Engineering services $165,000	10,900	0
6. Relocation costs $825,000	54,700	0
Subtotal	255,500	0
Total Adverse Effects	$ 255,500	
Net Beneficial Effects	+ $ 178,900	

ENVIRONMENTAL QUALITY ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Increase lake habitat for waterfowl, aquatic mammals and fish by 608 surface acres.
2. Destroy 608 acres of terrestrial wildlife by raising levels of existing lakes.
3. Reduce streamflow fluctuations.
4. Reduce streamflow discharges from the Green River to the Colorado River.
5. Increase sedimentation during construction.

SOCIAL WELL-BEING ACCOUNT
BENEFICIAL AND ADVERSE EFFECTS

1. Create 50 temporary jobs during installation period.
2. Create 1 permanent job for maintenance.
3. Utilize 110,000 acre-feet of available Colorado River Compact water.
4. Consume fossil fuels during construction.

1/ Amortized 100 years @ 6 5/8 percent interest.
2/ Actual benefits accruing directly to the user.
3/ Induced benefits accruing to various sectors of the economy.
4/ A structure on Pole Creek (Half Moon Lake) could be substituted to use available water; 47,000 acre-feet of water could be stored for an average annual cost of $2.20 per acre-foot.
5/ Developing new irrigated agricultural land with this water was not analyzed. Future winter forage needs can be met by improving late season water supplies, improving irrigation efficiency, and raising present production of hayland and pastureland to yield potentials.

***It is important to note that Wyoming can store water in the Green River Basin in excess of that allocated by the Colorado River Compact provided the state meets the 10-year average flow requirements at the Utah-Wyoming state line. Storage of this water would be advantageous to Wyoming as it would allow more flexibility in the management of the annual variable water supply in the basin.

Table VIII-6 Summary of planning alternative C effects for year 2000, Green River Basin, Wyoming

Accounts	Unit	Plan C
A. ECONOMIC DEVELOPMENT		
1. Plan elements evaluated for benefits and costs		
a. Beneficial effects	Av. Ann. $	15,278,500 1/
b. Adverse effects	Av. Ann. $	8,961,800
c. Net beneficial effects	Av. Ann. $	+6,316,700 1/
2. Plan elements evaluated for costs only		
a. Beneficial effects - not evaluated in monetary terms, benefits assumed at least equal to costs	--	--
b. Adverse effects	Av. Ann. $	2,005,700
B. ENVIRONMENTAL QUALITY (Beneficial and adverse effects)		
1. Areas of natural beauty		
a. Change rangeland and forest land to recreation facilities.	Acres	245
b. Improve recreation site aesthetics.	Yes or No	Yes
c. Preserve and enhance scenic stream corridors.	Miles	2,360
d. Decrease visual quality by increasing activity on commercial forest land.	Yes or No	Yes
e. Improve visual quality on rangeland.	Acres	513,000
2. Quality consideration of water, land, and air resources.		
a. Improve water quality by decreasing TDS (amount undetermined), and nutrients entering the Green River and reservoirs.	Yes or No	Yes
b. Increase forage production.	AUMs	198,300
c. Improve irrigation efficiency.	Acres	48,200
d. Reduce soil erosion on rangeland, roads and trails.	Acres	513,000
e. Increase human activity on recreation areas.	Yes or No	Yes
f. Increase human activity on new accessible streams.	Miles	562
g. Reduce erosion and sedimentation on streams.	Miles	100
h. Increase erosion and sediment during construction and logging.	Yes or No	Yes
i. Reduce Green River water discharge to Colorado River.	Yes or No	Yes
j. Increase human activities on commercial forest land.	Yes or No	Yes
k. Improve fish management on streams.	Yes or No	Yes
l. Decrease forest fire, disease, and insect hazards.	Yes or No	Yes
m. Harvest timber in wilderness study and roadless areas.	Yes or No	Yes
n. Reduce use concentration in wilderness area from people and livestock.	Management unit	9
3. Biological resources and selected ecosystems		
a. Increase open water wetlands.	Acres	1,883
b. Inundate perennial streams.	Miles	8
c. Inundate terrestrial wildlife habitat.	Acres	6,883
d. Decrease phreatophytes and associated wildlife along streams.	Yes or No	Yes
e. Reduce stream flow fluctuations.	Yes or No	Yes
f. Improve channel crossing for livestock and wildlife.	Yes or No	Yes
g. Preserve fishing stream habitat.	Miles	1,460
h. Create waterfowl breeding habitat.	Acres	7,800
i. Enhance waterfowl breeding habitat.	Acres	4,800
j. Improve critical winter habitat for big game animals.		
1. Antelope	Acres	251,000
2. Mule Deer	Acres	255,000
3. Elk	Acres	171,300
4. Moose	Acres	73,500
k. Reduce waterfowl habitat associated with cropland.	Ac. of cropland	58,100
4. Irreversible or irretrievable commitment of resources		
a. Commit rangeland and forest land to recreation areas.	Acres	245
b. Commit perennial stream to reservoir.	Miles	8
c. Commit Colorado River Compact water to various uses.	Acre-feet	188,200
d. Consume fossil fuels during construction.	Yes or No	Yes
C. SOCIAL WELL-BEING (Beneficial and adverse effects)		
1. Create temporary jobs during installation of structures and land treatment.	Jobs	1,059
2. Create permanent jobs.	Jobs	135
3. Create seasonal jobs.	Jobs	114
4. Improve ranch unit stability.	Yes or No	Yes
5. Improve recreation experience for visitors.	Yes or No	Yes
6. Utilize Colorado River Compact water in Wyoming.	Acre-feet	188,200
7. Reduce landowner rights along streams.	Acres	91,800
8. Improve overall hunting quality.	Yes or No	Yes
9. Increase hunting opportunities.	Yes or No	Yes
10. Improve fishing quality.	Yes or No	Yes
11. Increase fishing opportunities.	Yes or No	Yes
12. Discover, protect or enhance archeological resources.	Acres	172,000
13. Discover, protect or enhance fossil resources.	Acres	1,789,000
14. Discover, protect or enhance historical resources.	Sites	90
15. Harvest renewable wood fiber resources on commercial forest land	Yes or No	Yes
16. Increase human activities on water area and associated land.	Acres	10,575
17. Increase or improve accessibility to commercial forest land.	Yes or No	Yes
18. Decrease number of visitors at certain times, limit choice of areas and limit motor vehicle use.	Yes or No	Yes
19. Decrease livestock grazing on critical winter range for wildlife.	Acres	750,800
20. Reduce future opportunities to appropriate water for agriculture.	Yes or No	Yes
21. Reduce real estate taxes to landowners.	Yes or No	Yes
22. Reduce tax revenue to local governments.	Yes or No	Yes
23. Provide more flexibility for meeting Colorado River Compact water commitments.	Yes or No	Yes
24. Protect natural resources for future generations.	Yes or No	Yes

1/ Includes direct and external benefits. See definitions of these benefits on individual display sheets for specific study objectives in Alternative C.

CHAPTER IX

POTENTIAL FOR IMPLEMENTATION OF A LAND AND WATER DEVELOPMENT PLANNING ALTERNATIVE

CHAPTER IX
POTENTIAL FOR IMPLEMENTATION OF A
LAND AND WATER DEVELOPMENT PLANNING ALTERNATIVE

U. S. Department of Agriculture Programs and Effects

Successful implementation of any planning alternative or portions thereof will require a "plan" of action or strategy by citizens and local and state units of government. Planning Alternative C is used here to illustrate potential USDA involvement because it combines elements of the national economic development alternative (A) and the environmental quality alternative (B). In addition, alternative C expresses local and regional preferences for development of land and water resources. A substantial part of planning alternative C could be implemented by accelerating ongoing USDA programs or exercising present USDA authorities, if personnel, funds and federal cost-sharing are available (Table IX-1). The actual accomplishments would depend largely on the priorities established by conservation districts, irrigation districts, ASCS (Agricultural Stabilization and Conservation Service) committees, Forest Service and the interest of private landowners (Table IX-2).

Environmental Impacts

Installing two irrigation storage structures (Burnt Lake and Silver-Spring Creeks) would provide water for an increase in winter forage production of 15,600 AUMs. Water would also be available for other uses, such as industry, municipalities, recreation and fish and wildlife. Lake habitat for fish and wildlife would increase by 635 acres. Terrestrial wildlife habitat would be reduced by 635 acres. Downstream flow fluctuations would be reduced. Three miles of perennial stream would be inundated.

Initiating improved irrigation water management systems on 13,900 acres of cropland would increase crop yields, conserve water, reduce or alter wetlands, and decrease the quality of terrestrial wildlife habitat.

Table IX-1 USDA programs or authorities which could assist in the implementation of alternative C, Green River Basin, Wyoming

Alternative C - specific study objectives and plan elements	United States Department of Agriculture programs, authorities, and types of assistance									
	ARS	ASCS	COOP. EXT. S.	ESCS	FmHA	FS	SCS-OPS.	SCS-PL566	SCS-RC&D	State-Fed. Coop. Forest Program
1. SPECIFIC STUDY OBJECTIVE - Improve irrigation water supplies for late season use on 4,000 acres (Part 1 of 2). This part displays projects that are feasible using direct benefits alone. Plan Element - Install two irrigation storage structures and initiate irrigation water management system on 4,000 acres. Storage structures are on Fall Creek (Burnt Lake) and Silver Creeks.	R	F		T,R	F	A	T	T,F	T,F	
2. SPECIFIC STUDY OBJECTIVE - Improve irrigation water supplies for late season use on 54,100 acres (Part 2 of 2). This part displays projects that are feasible only by using direct and external benefits. Plan Element - Install six irrigation storage structures and initiate irrigation water management systems on 44,200 acres. Storage structures are on Horse Creek (2 sites), North Piney Creek (1 site), and Middle and South Piney Creeks (3 sites). Accelerate land treatment to improve irrigation efficiency on the remaining 9,900 acres having water shortages.	R	F		T,R	F	A	T		T,F	
3. SPECIFIC STUDY OBJECTIVE - Increase the utilization of fuelwood and small wood products. Plan Element - Increase annual harvest of fuelwood to 2,170 cords; to the number of posts to 1,650; and the number of poles to 8,350.	R		T	T,R		A	T			T,F
4. SPECIFIC STUDY OBJECTIVE - Increase roundwood production by 5.1 MMcu.ft. and maintain 1970 harvest level of 7.4 MMcu.ft. (Note - Annual harvest estimated to be 3.0 MMcu.ft. for year 2000 without project action). Plan Element - Install commercial forest land treatment measures on 75,000 acres. Practices include site preparation and planting on 24,000 acres and thinning on 51,000 acres. Harvest annually 7.4 MMcu.ft. of roundwood from portions of the 542,000 acres of commercial forest land.		F	T	T,R		A	T			T,F
5. SPECIFIC STUDY OBJECTIVE - Reduce erosion on 513,000 acres of rangeland. Plan Element - Install grazing management systems on 513,000 acres to reduce erosion. Practices to reduce erosion include grazing management, fencing, water development, and grade stabilization structures.	R	F	T		F		T	T	T,F	
6. SPECIFIC STUDY OBJECTIVE - Improve management of the present recreation activity opportunities and recreation facility maintenance program on all developed sites, dispersed areas and recreation trails. Plan Element - Increase funding by $642,100 annually. Detailed funding increases as follows: Developed areas: Maintenance - $151,700, Operation - $276,000 Dispersed areas: Maintenance - $ 16,700, Operation - $ 62,500 Recreation trail: Maintenance - $134,500			T			A	T			
7. SPECIFIC STUDY OBJECTIVE - Increase recreation facilities. Plan Element - Install new recreation facilities as follows: 8 boat launching sites, 79 picnic grounds (3 units each), 7 campgrounds (25 units each,), and acquire access to 562 miles of fishing stream.			T	T,R		A	T	T,F	T,F	
8. SPECIFIC STUDY OBJECTIVE - Protect 800 miles of privately-owned stream corridors in visual classes 5, 4, and 3. Plan Element - Enact local protective zoning with tax credits on 800 miles (38,800 acres) of stream corridor.										
9. SPECIFIC STUDY OBJECTIVE - Reduce concentrated use in local areas within nine wilderness management units of the Bridger Wilderness Area. Plan Element - Initiate a use permit system, employ personnel to operate entrance stations, employ more wilderness patrol personnel, relocate trails, remove some cabins, and improve animal and human waste management.						A				

Table IX-1 USDA programs or authorities which could assist in the implementation of alternative C, Green River Basin, Wyoming

Alternative C - specific study objectives and plan elements	United States Department of Agriculture programs, authorities, and types of assistance									
	ARS	ASCS	COOP. EXT. S.	ESCS	FmHA	FS	SCS-OPS.	SCS-PL566	SCS-RC&D	State-Fed. Coop. Forest Program
10. SPECIFIC STUDY OBJECTIVE - Identify critical archeologic and fossil areas. Plan Element - Accelerate the general reconnaissance of the basin for archeological resources on 172,000 acres and paleontological resources on 1,789,000 acres.										
11. SPECIFIC STUDY OBJECTIVE - Preserve and improve 90 historic sites. Plan Element - Install roads, signs, parking areas, and foot trails. Initiate schedule operations, maintenance, police patrols, and necessary replacements. Site by counties are Carbon - 3, Fremont - 25, Sublette - 17, Sweetwater - 23, and Uinta - 22.						A				
12. SPECIFIC STUDY OBJECTIVE - Reduce streambank erosion on 100 miles of stream. Plan Element - Install streambank stabilization structures, grade stabilization structures, fences, adaptable trees and shrubs, and institute proper grazing use along 100 miles of stream.	R	F	T				T		T,F	
13. SPECIFIC STUDY OBJECTIVE - Provide minimum flows for a viable fishery on 174 miles of stream. Plan Element - Enact a minimum stream flow law for fish and other aquatic resources. Law should allow appropriation of water for fish (nonconsumptive use) in existing reservoirs if supply is available.										
14. SPECIFIC STUDY OBJECTIVE - Maintain quality on 1,460 miles of very good to premium classified fishing streams. Plan Element - Accelerate landowner cooperative program to further protect and rehabilitate fishing streams. Enact and enforce a stream protection law in Wyoming.						A	T		T,F	
15. SPECIFIC STUDY OBJECTIVE - Enhance and create wetlands for waterfowl habitat. Plan Element - Install habitat improvement measures on 4,800 acres of wetland and create 7,800 acres of wetland.			T				T	T	T,F	
16. SPECIFIC STUDY OBJECTIVE - Enhance and protect critical winter habitat for selected resident wildlife species. Plan Element - Accelerate installation and initiation of habitat improvement practices on critical winter range. Habitat types to improve are: antelope - 251,000 acres; mule deer - 255,000 acres; elk - 171,300 acres; and moose - 73,500 acres.	R		T			A	T	T		
17. SPECIFIC STUDY OBJECTIVE - Utilize 188,200 acre-feet of Colorado River Compact water in basin. Plan Element - Previous plan elements to improve late season irrigation water supplies and create wetlands for waterfowl use 78,200 acre-feet of water. Remaining compact water available for storage and use is 110,000 acre-feet. Plan elements displayed here are to construct dams with sufficient active storage capacity to store 110,000 acre-feet at the lowest possible costs. Storage sites are on Pine Creek (Fremont Lake) and Boulder Creek (Boulder Lake).				T,R	F					

Agency and program names

ARS - Agricultural Research Service
ASCS - Agricutlral Stabilization and Conservation Service
COOP.EXT.S. - Cooperative Extension Service
ESCS - Economics, Statistics, and Cooperatives Service
FmHA - Farmers Home Administration
FS - Forest Service
SCS-OPS - Soil Conservation Service - Conservation Operations
SCS-PL566 - Soil Conservation Service - Watershed Program
SCS-RC&D - Soil Conservation Service - Resource Conservation and Development
State-Fed. Forest Prog. - State and Federal Cooperative Forestry Program

Types of assistance 1/

T - Technical
F - Financial (cost-share or low interest loans)
R - Research
A - Program authority on land owned by Forest Service

1/ Does not include any necessary permits.

Table IX-2 Capability of current USDA programs to assist in the implementation of alternative C and satisfy needs for year 2000, Green River Basin, Wyoming

Specific study objectives	Unit of measure	Year 2000 total need 1/	Needs satisfied by alternative C	Potential USDA portion of alternative C	Alternative C minus USDA portion	Total need minus USDA portion = total remaining need
1. Improve irrigation water supplies for late season use.	Acres	58,100	48,200	4,000	44,200	54,100
2. Reduce salt loading to the Green River from the Big Sandy and Blacks Forks Rivers and Henrys Fork.	Watershed	3	0	—	--	3
3. Improve irrigation water use efficiency.	Acres	52,500	48,200 2/	4,000	44,200	48,500
4. Increase the utilization of fuelwood and small wood products annually.	Cords (each)	2,170	2,170	2,170	0	0
	Posts (each)	1,650	1,650	1,650	0	0
	Poles (each)	8,350	8,350	8,350	0	0
5. Increase roundwood: production	MMcu.ft.	5.1	5.1	5.1	0	0
harvest	MMcu.ft.	18.7	7.4	7.4	0	11.3
6. Reduce erosion on rangeland.	Acres with erosion rate below 0.5 ton/ac./yr (thousands)	1,026.3	513.0	513.0	0	513.0
7. Improve management of the present recreation activity opportunities and recreation facility maintenance program.	Dollars (annually)	642,100	642,100	449,000	193,100	193,100
8. Increase recreation facilities						
Boat launching	Sites (no.)	8	8	4	4	4
Picnic grounds	Sites (no.)	79	79	8	71	71
Campgrounds	Sites (no.)	7	7	5	2	2
Fishing - miles of streams with access	Stream miles	562	562	0	562	562
9. Utilize available Colorado River Compact water in basin.	Acre-ft. (annually)	188,200 3/	188,200	29,900	158,300	158,300
10. Increase production of winter livestock forage.	AUMs (annually)	100,000	100,000 4/	15,600	84,400	84,400
11. Protect and enhance scenic stream corridors.	Protected miles of stream corridor	1,170	800	0	800	1,170
12. Reduce concentrated use in local areas within wilderness management units.	Number of properly managed wilderness management units	9	9	9	0	0
13. Identify and protect significant archeologic and fossil areas.	Acres reconned					
	archeological	344,000	172,000	172,000	0	172,000
	fossil	3,578,500	1,789,000	0	1,789,000	3,578,500
14. Preserve historical sites.	Sites adequately protected	113	90	0	90	113
15. Reduce streambank erosion.	Miles of stream	200	100	50	50	150
16. Provide minimum flows for a viable fishery on certain streams.	Miles of stream	188	174	0	174	188
17. Maintain fishing stream quality.	Miles of stream	1,460	1,460	0	1,460	1,460
18. Enhance and create waterfowl habitat.	Acres - enhanced	19,000	4,800	0	4,800	19,000
	created	7,800	7,800	0	7,800	7,800
19. Enhance and protect critical winter habitat for selected resident wildlife species.	Antelope (acres)	501,700	251,000	251,000	0	250,700
	Mule deer (acres)	510,000	255,000	255,000	0	255,000
	Elk (acres)	171,300	171,300	171,300	0	0
	Moose (acres)	73,500	73,500	73,500	0	0

1/ Year 2000 need includes 1980 time frame need.
2/ Needs satisfied by plan element for specific Study Objective 1.
3/ Need figure used here is for the year 2020.
4/ Needs satisfied by plan elements for specific Study Objectives 1, 3, and 6 exceed 100,000 AUMs.

Increasing timber sales offerings on Forest Service land to harvest annually 7.4 MMcu.ft. of roundwood would alter wildlife habitat over a 20-year period, increase soil erosion during logging operations, harvest roundwood from present wilderness study and roadless areas, alter visual quality on an additional 121,400 acres of commercial forest and utilize a renewable resource. Encouraging additional special timber sales permits to increase annual harvest for fuelwood to 2,170 cords, for posts to 1,650, and for poles to 8,350 would increase human activity on commercial forest land. Fire, disease, and insect hazards would be reduced. Installing commercial forest land treatment measures on 75,000 acres would increase wood fiber production, improve wildlife habitat and reduce soil erosion.

Installing grazing management systems on 513,000 acres would reduce soil erosion, improve the quality of terrestrial wildlife habitat, and improve quality of cold water streams in rangeland areas.

Installing streambank stabilization structures and associated measures along 100 miles of stream would improve water quality and stream channels for fish habitat and improve riparian wildlife habitat. Reductions of erosion and sedimentation and nutrient loading in streams and reservoirs would result. Visual quality along 100 miles of stream would improve.

Increasing funding by $642,100 annually for operations and maintenance of recreation activities and facilities would result in reduced erosion on roads and trails and improved aesthetic quality of recreation activities in localized areas. Constructing 8 boat launching sites, 79 picnic grounds (3 units each), and 7 campgrounds (5 units each), and acquiring access to 562 miles of fishing stream would change 245 acres of rangeland or forest land to recreation facilities and increase human activity at new facilities and the land adjacent to them. Improved fishery management could be undertaken on 562 miles of stream.

Initiating use permit system, employing personnel to operate entrance stations, employing more wilderness patrol personnel, relocating trails, removing some cabins, and improving animal and human waste management would improve the utilization and aesthetic and environmental quality of many areas within nine wilderness management units of the Bridger Wilderness Area.

Installing habitat improvement measures such as, nesting structures and stream island maintenance, on 4,800 acres of wetland and creating 7,800 acres of wetland would enhance and provide habitat for waterfowl and other wildlife. About 5,000 acres of sagebrush-grassland and 2,800 acres of greasewood-saline flats would be changed to permanent wetland. Agricultural water (20,000 acre-feet) would be changed to waterfowl use.

Accelerating the installation and initiation of habitat improvement practices on critical winter range for antelope - 251,000 acres; mule deer - 255,000 acres; elk - 171,300 acres; and moose - 73,500 acres would decrease winter mortality losses, improve habitat for several

species of nongame birds and mammals, reduce soil erosion and decrease perennial water sources on critical winter range.

Economic, environmental and social well-being impacts of alternative C and the USDA portion of alternative C are shown in Table IX-3.

Adverse Environmental Impacts Which Could Not Be Avoided

Recreation facility expansions would use 161 acres of rangeland or forest land. Visual quality would be impaired during and shortly after logging operations. Human activity would increase on recreation facilities and in logging areas. Erosion and sedimentation would increase during construction activities for dams and recreation facilities and during logging operations. Reservoirs would inundate 3 miles of perennial stream and 635 acres of terrestrial wildlife habitat. Water committed to consumptive use in the basin would amount to 29,900 acre-feet.

Alternatives

One alternative to the plan elements of alternative C would be a "future without action." Trends would continue in the basin as discussed in Chapter VI.

Alternative A (NED) emphasizes plan elements for economic development by USDA programs. The effects of this alternative are displayed in Tables VIII-3 and 4. As compared with alternative C, this alternative would result in a larger number of wetland acres being lost or altered as a result of improved irrigation efficiencies. Alternative A does not include plan elements to protect, preserve and enhance fish and wildlife habitat, landscape aesthetics, or cultural resources.

Alternative B (EQ) emphasizes plan elements for environmental quality preservation and enhancement. Most programs to implement this alternative are non-USDA. The effects are displayed on Tables VIII-3 and 5. As compared with alternative C, this alternative would result in more acres of management for wetlands and other wildlife habitat and more protection of free-flowing rivers.

Relationship Between Local Short-term Uses of Man's Environment and The Maintenance of Long-term Productivity

The USDA portion of alternative C would contribute to the continued use of agricultural and forest lands. Maintenance and improvement of the productive capacity of these lands would occur in the basin. Improving irrigation efficiencies would conserve water for agricultural and other uses within the basin.

Measures for enhancement of fish and wildlife habitat would have a sustaining positive impact in both the short-term and the long-term.

Table IX-3 Impacts of potential USDA programs which could assist in the implementation of alternative C, Green River Basin, Wyoming

Accounts	Unit	Plan C impacts	Impacts of USDA portion
A. ECONOMIC DEVELOPMENT			
1. Plan elements evaluated for benefits and costs			
a. Beneficial effects	Av. Ann. $	15,278,500 1/	2,814,100
b. Adverse effects	Av. Ann. $	8,961,800	1,689,300
c. Net beneficial effects	Av. Ann. $	+6,316,700 1/	+1,124,800
2. Plan elements evaluated for costs only			
a. Beneficial effects - not evaluated in monetary terms, benefits assumed at least equal to costs	--	--	--
b. Adverse effects	Av. Ann. $	2,005,700	837,700
B. ENVIRONMENTAL QUALITY (Beneficial and adverse effects)			
1. Areas of natural beauty			
a. Change rangeland and forest land to recreation facilities.	Acres	245	161
b. Improve recreation site aesthetics.	Yes or No	Yes	Yes
c. Preserve and enhance scenic stream corridors.	Miles	2,360	0
d. Decrease visual quality by increasing activity on commercial forest land.	Yes or No	Yes	Yes
e. Improve visual quality on rangeland.	Acres	513,000	513,000
2. Quality consideration of water, land, and air resources.			
a. Improve water quality by decreasing TDS (amount undetermined), and nutrients entering the Green River and reservoirs.	Yes or No	Yes	Yes
b. Increase forage production.	AUMs	198,300	15,600
c. Improve irrigation efficiency.	Acres	58,100	13,900
d. Reduce soil erosion on rangeland, roads and trails.	Acres	513,000	513,000
e. Increase human activity on recreation areas.	Yes or No	Yes	Yes
f. Increase human activity on new accessible streams.	Miles	562	0
g. Reduce erosion and sedimentation on streams.	Miles	100	100
h. Increase erosion and sediment during construction and logging.	Yes or No	Yes	Yes
i. Reduce Green River water discharge to Colorado River.	Yes or No	Yes	Yes
j. Increase human activities on commercial forest land.	Yes or No	Yes	Yes
k. Improve fish management on streams.	Yes or No	Yes	Yes
l. Decrease forest fire, disease, and insect hazards.	Yes or No	Yes	Yes
m. Harvest timber in wilderness study and roadless areas.	Yes or No	Yes	Yes
n. Reduce use concentration in wilderness area from people and livestock.	Management unit	9	9
3. Biological resources and selected ecosystems			
a. Increase open water wetlands.	Acres	1,883	635
b. Inundate perennial streams.	Miles	8	3
c. Inundate terrestrial wildlife habitat.	Acres	6,883	635
d. Decrease phreatophytes and associated wildlife along streams.	Yes or No	Yes	Yes
e. Reduce stream flow fluctuations.	Yes or No	Yes	No
f. Improve channel crossing for livestock and wildlife.	Yes or No	Yes	Yes
g. Preserve fishing stream habitat.	Miles	1,460	0
h. Create waterfowl breeding habitat.	Acres	7,800	0
i. Enhance waterfowl breeding habitat.	Acres	4,800	0
j. Improve critical winter habitat for big game animals.			
1. Antelope	Acres	251,000	251,000
2. Mule Deer	Acres	255,000	255,000
3. Elk	Acres	171,300	171,300
4. Moose	Acres	73,500	73,500
k. Reduce waterfowl habitat associated with cropland.	Ac. of cropland	58,100	13,900
4. Irreversible or irretrievable commitment of resources			
a. Commit rangeland and forest land to recreation areas.	Acres	245	161
b. Commit perennial stream to reservoir.	Miles	8	3
c. Commit Colorado River Compact water to various uses.	Acre-feet	188,200	29,900
d. Consume fossil fuels during construction.	Yes or No	Yes	Yes
C. SOCIAL WELL-BEING (Beneficial and adverse effects)			
1. Create temporary jobs during installation of structures and land treatment.	Jobs	1,059	429
2. Create permanent jobs.	Jobs	135	40
3. Create seasonal jobs.	Jobs	114	114
4. Improve ranch unit stability.	Yes or No	Yes	Yes
5. Improve recreation experience for visitors.	Yes or No	Yes	Yes
6. Utilize Colorado River Compact water in Wyoming.	Acre-feet	188,200	29,900
7. Reduce landowner rights along streams.	Acres	91,800	No
8. Improve overall hunting quality.	Yes or No	Yes	Yes
9. Increase hunting opportunities.	Yes or No	Yes	Yes
10. Improve fishing quality.	Yes or No	Yes	Yes
11. Increase fishing opportunities.	Yes or No	Yes	Yes
12. Discover, protect or enhance archeological resources.	Acres	172,000	0
13. Discover, protect or enhance fossil resources.	Acres	1,789,000	0
14. Discover, protect or enhance historical resources.	Sites	90	0
15. Harvest renewable wood fiber resources on commercial forest land	Yes or No	Yes	Yes
16. Increase human activities on water area and associated land.	Acres	10,575	735
17. Increase or improve accessibility to commercial forest land.	Yes or No	Yes	Yes
18. Decrease number of visitors at certain times, limit choice of areas and limit motor vehicle use.	Yes or No	Yes	Yes
19. Decrease livestock grazing on critical winter range for wildlife.	Acres	750,800	750,800
20. Reduce future opportunities to appropriate water for agriculture.	Yes or No	Yes	No
21. Reduce real estate taxes to landowners.	Yes or No	Yes	No
22. Reduce tax revenue to local governments.	Yes or No	Yes	No
23. Provide more flexibility for meeting Colorado River Compact water commitments.	Yes or No	Yes	Yes
24. Protect natural resources for future generations.	Yes or No	Yes	Yes

1/ Includes direct and external benefits. See definitions of these benefits on individual display sheets for specific study objectives in Alternative C, Chapter VIII.

Dispersed use of national forest lands would help protect the quality of the forest area for use by succeeding generations.

Irreversible and Irretrievable Commitment of Resources

Water impoundments would result in a commitment of 635 acres of bottomland and upland habitat and include three miles of stream habitat for trout. New recreation facilities would commit 161 acres of rangeland to recreation use. A related commitment would be required for labor, construction materials, and fossil fuels. Water depletions for irrigation and wetland development would amount to 29,900 acre-feet.

The USDA agencies and their respective programs which could assist in the implementation of alternative C are discussed below.

Science and Education Administration

Agricultural Research Service

The ARS conducts research and development work on the production, utilization and marketing of agricultural products, on human nutrition and on other matters of concern to consumers. The Service also conducts regulatory programs involving the enforcement of plant and animal quarantines.

The farm research that ARS conducts is their most important function in relationship to this study report. Farm research is conducted to improve methods of soil and water management; to improve field and horticultural crops in many other areas not specifically related to objectives of this study.

Cooperative Extension Service

The Wyoming Extension Service is part of the Federal-State Cooperative Extension Service partnership. Federal, state and county governments share in financing, planning and carrying out information and education programs. The Extension Service acts as the educational agency of the U.S. Department of Agriculture. State extension specialists and county agents cooperate with other agencies to provide local information relating to conservation programs, weed control, crop culture, animal culture, herbicides, pesticides, fertilizers, homemaking and other types of information and assistance.

Agricultural Stabilization and Conservation Service

The ASCS has administered the Agricultural Conservation Program or a similar program for a number of years. The major purpose of these programs is to improve the quality of life for all people by helping farmers and ranchers to prevent pollution of land, water and air and to conserve soil, water, woodland and wildlife resources. This is done

with financial assistance through the ASCS and with technical assistance of the SCS and Forest Service.

The major types of practices encouraged are those which establish, improve or protect the soil with a cover of trees, grasses or legumes; provide primarily for the conservation or safe disposal of water; provide for pollution abatement or environmental enhancement; and provide protection from erosion. Emphasis is given to enduring practices which are needed to solve high priority problems as identified by county committees.

A farmer or rancher who desires assistance must file a request before he starts the practice for which he desires assistance. Approval is based on a decision as to the priority of the practice. Cost-sharing is based on acceptable completion and maintenance of the practice. Groups of two or more are encouraged to participate in pooling agreements. Cost-sharing rates vary by practice.

Economics, Statistics and Cooperatives Service

Economic Research

The Economic Research group conducts national and regional programs of research, planning and technical consultation and services pertaining to economic and institutional factors and policies which relate to the use, conservation, development, management and control of natural resources. This includes estimating the extent, geographic distribution, productivity, quality and contribution of natural resources to regional and national economic activity and growth. Also included are: resource requirements, development potentials and resource investment economics; impact of technological and economic change on the utilization of natural resources; resource income distribution and valuation; and the recreational use of resources.

Farmers Home Administration

The Farmers Home Administration provides financial, technical, and management assistance to individuals and organizations (private or public). The overall objective is to strengthen family farms and rural communities. There is a Farmers Home Administration office serving every rural community in the United States.

In the broadest sense, the legislative authority for the various loan programs administered by the Farmers Home Administration is the Consolidated Farmers Home Administration Act of 1961, as amended. Authorities under the various sections of the Act are very broad and include in part the following specific loan purposes: purchase, enlargement and improvement of family-type farms; farm operating expenses, purchase of farm machinery, livestock and equipment; construction of rural homes and farm service buildings; development of community water and waste disposal facilities (PL-87-128, Section 306); development of recreational facilities; watershed development (PL-566, Section 8); soil and water conservation; shifts in land use; rural renewal projects; and resource conservation and development (PL-87, Section 703).

Forest Service

The U.S. Forest Service administers national forest lands under the multiple use concept to provide forest products, recreation, forage and watershed protection. The Forest Service also has cooperative agreements with the Wyoming State Forester, who is the official responsible for forestry matters on state and private forest lands in Wyoming.

Cooperative State-Federal Forestry Program

The U.S. Forest Service and the Wyoming State Forestry Division of the State Land Office cooperate in several programs. The Clarke-McNary Cooperative Fire Control Program in Wyoming was 19 years old on April 8, 1978. Since 1959, 21 counties, the State Game and Fish Commission, the State Recreation Commission and the Highway Department have made formal agreements with the State Board of Land Commissioners for improved fire protection on over 27,000,000 acres of state and private forested and nonforested watershed lands. The effect of the program is bringing basic organized fire protection to all rural lands within each participating county.

Under the authority of the Cooperative Forest Management Act of August 25, 1950, the State of Wyoming entered this Cooperative Forest Management Program on January 5, 1962. The purpose of the program is to improve and maintain the productivity of state and private forest lands; to reduce waste in harvesting, marketing and in the primary processing for forest products; and by so doing, assist in increasing the income and general welfare of the people of the state. Technical forestry assistance is provided to private forest owners in forest management planning, timber sales, utilization and marketing of forest products, tree thinning, forest protection, etc. Similar service is provided to processors of primary forest products in locating raw material, operation and layout of mill and processing equipment, and otherwise promoting increased efficiency in the primary processing of forest products.

The objective of the Forest Pest Control is to protect state and private forest resource values against damage and loss caused by forest insects and diseases. This is accomplished through continuing and periodic activities to prevent, detect, evaluate and suppress forest insect infestations and disease conditions on state and private lands. Participation in the program is carried out under the Forest Pest Control Act of August 1947.

The State Forestry Division cooperates with the Forest Service and the Soil Conservation Service in the planning and development of small watershed projects. The division is responsible for the examination and recommendation of land treatment measures on all classes of state land and private forested land. These recommended measures are for range improvements, tree planting, erosion control, etc.

National Forest Development and Multiple Use Programs

Watershed management practices include gully control and coordination of other resource uses with watershed management. Measures benefiting watersheds include range revegetation and type conversion, range fencing to protect problem areas and newly established vegetation, and reforestation and afforestation.

Timber management activities under existing programs include up-to-date inventories on all national forest lands; better sale preparation and administration; reduction of insect and disease losses; improved utilization of available timber on sale areas and from conversions and other clearings; better accessibility by constructing roads and bridges; release, weeding, thinning and pruning; reforestation and afforestation; reduction of fire losses; and continued research to improve genetic characteristics of trees and provide better silvicultural practices.

The development and management activities under existing range resource programs are: complete allotment inventories and management plans for all national forest land; revegetation, plant control and type conversion; and construction of range fence, stock distribution trails and stockwater developments.

Most of the outstanding natural attractions and potential outdoor recreation areas are in the national forests. It is the objective of the Forest Service to develop and manage these recreation resources to meet public demand in terms of kind, quantity and quality. Applicable measures are trail construction and improvement, road construction and improvement and roadside observation sites, vista points and scenic turnouts. Forest Service programs emphasize dispersed recreation and appropriate support facilities.

The Forest Service program is designed to enhance wildlife and fishery habitats, restore forest quality and mitigate losses from development and land use changes. Measures include stream habitat improvement, lake habitat improvement and fencing to protect key wildlife areas.

Soil Conservation Service

The Soil Conservation Service (SCS) assists conservation districts in giving technical assistance to individuals, groups, organizations, towns, cities, counties and state governments in reducing costly waste of land and water resources and in using them according to their capabilities. This is accomplished through unified planning that combines all the technologies, considers all the resources and recognizes the human interests that apply to each area of land and water use. The major SCS programs available to residents of the basin are described below.

Assistance to Landowners and Units of Government

The SCS has a basic continuing program of providing technical assistance in the conservation of land, water and related resources as requested by landowners and state and local governments which have planning authority. Conservation districts provide local direction, leadership and coordination of this program.

Soil surveys and water supply forecasting are supporting activities in planning the wise use of land and water. Detailed soil surveys and generalized soils maps can be made available. This information can be obtained from the local SCS offices. Water supply forecasts are published monthly from February through May each year. Some information from these forecasts is published in local newspapers. Detailed information can be obtained from local SCS offices. Interested individuals may request to have their names placed on the regular mailing list and receive a copy of each monthly forecast.

Watershed Protection Projects

The SCS provides technical and cost-sharing assistance in planning, designing and installing land treatment measures and structural works of improvement in small watershed projects (250,000 acres or less). These projects are designed to reduce floodwater, erosion and sediment damages and to promote other water and related land management and development practices as desired by the local sponsors of these projects. Applications for assistance are submitted to the U.S. Secretary of Agriculture through the Wyoming State Conservation Commission and the State Conservationist of the SCS.

Resource Conservation and Development Project (RC&D)

The SCS is responsible for coordination of U.S. Department of Agriculture RC&D activities and provides technical and financial assistance to locally sponsored RC&D areas. The objective is to expand socioeconomic opportunities for the poeple of an area by assisting them in developing and carrying out plans of action for the orderly conservation, improvement, development and wise use of their natural resources.

Applications for RC&D areas are submitted to the U.S. Secretary of Agriculture through the Wyoming State Conservation Commission and the State Conservationist of the SCS. When an area is authorized for planning assistance, a coordinator is appointed who assists local sponsors in developing a plan. Most RC&D areas have citizen and advisory committees for agriculture, forestry, water resources, business and industry, transportation, health, education, recreation and wildlife and community facilities. Policies and priorities are set by a steering committee or executive council composed of the representatives from the sponsoring units of government. The RC&D area then becomes eligible for technical and financial assistance in project measures. Lincoln, Sublette, Sweetwater and Uinta Counties are located within the Western Wyoming RC&D area.

Agency Programs Outside USDA

Agencies outside of USDA and their respective programs which could assist in the implementation of alternative C are discussed below. Further details are given in Table IV-4.

Wyoming State Conservation Commission

The Wyoming State Conservation Commission assists and guides 39 conservation districts throughout Wyoming in the development of conservation education programs, information programs and total resource conservation programs to promote multiple and wise use of our natural resources in urban and rural development. Each conservation district is governed by five local citizens. Conservation of our soil and water resources is improved as the districts assist in irrigation projects, mine reclamation, soil surveys and conservation planning for individuals, groups and units of government.

The Wyoming State Conservation Commission is the state agency designated by the Governor to review and approve small watershed projects and RC&D project applications and plans. The Commission sets the priorities and direction for Soil Conservation Service activities on small watershed projects. The Commission may also assist in accelerating work on these projects by employing consultants to acquire basic information for preliminary investigations of feasibility.

Wyoming Department of Agriculture

The State Department of Agriculture is assisting agriculture in Wyoming to meet the needs of the present and future and to add to the economy of the state. Departmental programs related to land and water and related resources development are described below.

Division of Markets

The Division of Markets furnishes technical assistance in the fields of transportation, marketing and statistical information to assist in the development of feasible programs with regard to freight rates, agribusiness, export and import of all agricultural products. The division has the responsibility of grading and inspection of produce entering and leaving the state. The Weights and Measures Section of this division inspects and tests all commercial weighing and measuring devices in the state and checks the correct quantity and weight of products and merchandise offered for sale.

Division of State Laboratories

The Division of State Laboratories located on the University of Wyoming campus at Laramie furnishes the expertise and equipment necessary to analyze fertilizers, pesticides, drugs, feeds, water potability, food or any commodity as it pertains to humans or animals.

Table IX-4 Other available programs and authorities which could assist in the implementation of alternative C, Green River Basin, Wyoming

Alternative C - specific study objectives and plan elements	Other available programs and authorities and types of assis												
	WSCS	WDA	St. of Wyo. land	WDE-PAD	WFLB	WSDF	WSE	WPSC	WG&F	WAC	BLM land	HCRS	BR land
1. SPECIFIC STUDY OBJECTIVE - Improve irrigation water supplies for late season use on 4,000 acres (Part 1 of 2). This part displays projects that are feasible using direct benefits alone. Plan Element - Install two irrigation storage structures and initiate irrigation water management system on 4,000 acres. Storage structures are on Fall Creek (Burnt Lake) and Silver Creeks.	T			T,R	F		T,F		T	T	A	T,F	
2. SPECIFIC STUDY OBJECTIVE - Improve irrigation water supplies for late season use on 54,100 acres (Part 2 of 2). This part displays projects that are feasible only by using direct and external benefits. Plan Element - Install six irrigation storage structures and initiate irrigation water management systems on 44,200 acres. Storage structures are on Horse Creek (2 sites), North Piney Creek (1 site), and Middle and South Piney Creeks (3 sites). Accelerate land treatment to improve irrigation efficiency on the remaining 9,900 acres having water shortages.	T		A	T,R	F		T,F		T,A	T	A	T,F	
3. SPECIFIC STUDY OBJECTIVE - Increase the utilization of fuelwood and small wood products. Plan Element - Increase annual harvest of fuelwood to 2,170 cords; to the number of posts to 1,650; and the number of poles to 8,350.	T		A	T,R		T			T				
4. SPECIFIC STUDY OBJECTIVE - Increase roundwood production by 5.1 MMcu.ft. and maintain 1970 harvest level of 7.4 MMcu.ft. (Note - Annual harvest estimated to be 3.0 MMcu.ft. for year 2000 without project action). Plan Element - Install commercial forest land treatment measures on 75,000 acres. Practices include site preparation and planting on 24,000 acres and thinning on 51,000 acres. Harvest annually 7.4 MMcu.ft. of roundwood from portions of the 542,000 acres of commercial forest land.	T		A	T,R		T,F			T		A		
5. SPECIFIC STUDY OBJECTIVE - Reduce erosion on 513,000 acres of rangeland. Plan Element - Install grazing management systems on 513,000 acres to reduce erosion. Practices to reduce erosion include grazing management, fencing, water development, and grade stabilization structures.	T		A						T		A		A
6. SPECIFIC STUDY OBJECTIVE - Improve management of the present recreation activity opportunities and recreation facility maintenance program on all developed sites, dispersed areas and recreation trails. Plan Element - Increase funding by $642,100 annually. Detailed funding increases as follows: Developed areas: Maintenance - $151,700, Operation - $276,000 Dispersed areas: Maintenance - $ 16,700, Operation - $ 62,500 Recreation trail: Maintenance - $134,500	T		A	T,R					T	T,F	A	T,F	
7. SPECIFIC STUDY OBJECTIVE - Increase recreation facilities. Plan Element - Install new recreation facilities as follows: 8 boat launching sites, 79 picnic grounds (3 units each), 7 campgrounds (25 units each,), and acquire access to 562 miles of fishing stream.	T		A	T,R					T	T,F	A	T,F	
8. SPECIFIC STUDY OBJECTIVE - Protect 800 miles of privately-owned stream corridors in visual classes 5, 4, and 3. Plan Element - Enact local protective zoning with tax credits on 800 miles (38,800 acres) of stream corridor.									T				
9. SPECIFIC STUDY OBJECTIVE - Reduce concentrated use in local areas within nine wilderness management units of the Bridger Wilderness Area. Plan Element - Initiate a use permit system, employ personnel to operate entrance stations, employ more wilderness patrol personnel, relocate trails, remove some cabins, and improve animal and human waste management.										T		T	

Alternative C - specific study objectives and plan elements	Other available programs and authorities and types of assistance														
	WSCS	WDA	St. of Wyo. land	WDE-PAD	WFLB	WSDF	WSE	WPSC	WG&F	WAC	BLM land	HCRS	BR land	FWS	GS
0. SPECIFIC STUDY OBJECTIVE - Identify critical archeologic and fossil areas. Plan Element - Accelerate the general reconnaissance of the basin for archeological resources on 172,000 acres and paleontological resources on 1,789,000 acres.			A						A	T,F	A	T,F	A		
1. SPECIFIC STUDY OBJECTIVE - Preserve and improve 90 historic sites. Plan Element - Install roads, signs, parking areas, and foot trails. Initiate schedule operations, maintenance, police patrols, and necessary replacements. Site by counties are Carbon - 3, Fremont - 25, Sublette - 17, Sweetwater - 23, and Uinta - 22.			A						A	T,F	A	T,F	A		
2. SPECIFIC STUDY OBJECTIVE - Reduce streambank erosion on 100 miles of stream. Plan Element - Install streambank stabilization structures, grade stabilization structures, fences, adaptable trees and shrubs, and institute proper grazing use along 100 miles of stream.	T		A						T		A		A		
3. SPECIFIC STUDY OBJECTIVE - Provide minimum flows for a viable fishery on 174 miles of stream. Plan Element - Enact a minimum streamflow law for fish and other aquatic resources. Law should allow appropriation of water for fish (nonconsumptive use) in existing reservoirs if supply is available.							T		T		A			T	T
4. SPECIFIC STUDY OBJECTIVE - Maintain quality on 1,460 miles of very good to premium classified fishing streams. Plan Element - Accelerate landowner cooperative program to further protect and rehabilitate fishing streams. Enact and enforce a stream protection law in Wyoming.			A						T		A			T	
15. SPECIFIC STUDY OBJECTIVE - Enhance and create wetlands for waterfowl habitat. Plan Element - Install habitat improvement measures on 4,800 acres of wetland and create 7,800 acres of wetland.	T		A				T		T		A			T	T
16. SPECIFIC STUDY OBJECTIVE - Enhance and protect critical winter habitat for selected resident wildlife species. Plan Element - Accelerate installation and initiation of habitat improvement practices on critical winter range. Habitat types to improve are: antelope - 251,000 acres; mule deer - 255,000 acres; elk - 171,300 acres; [redacted] moose - 73,500 acres.	T		A						T,F		A		A	T	
7. SPECIFIC STUDY OBJECTIVE - Utilize 188,200 acre-feet of Colorado River Compact water in basin. Plan Element - Previous plan elements to improve late season irrigation water supplies and create wetlands for waterfowl use 78,200 acre-feet of water. Remaining compact water available for storage and use is 110,000 acre-feet. Plan elements displayed here are to construct dams with sufficient active storage capacity to store 110,000 acre-feet at the lowest possible costs. Storage sites are on Pine Creek (Fremont Lake) and Boulder Creek (Boulder Lake).	T	T	A	T	F		T	T	T,F	T,F	A			T	

Agency names

WSCS - Wyoming State Conservation Commission and Conservation Districts
WDA - Wyoming Department of Agriculture
WDEPAD - Wyoming Department of Economic Planning and Development
WFLB - Wyoming Farm Loan Board
WSFD - Wyoming State Forestry Division, manage forested state lands and participate in state-federal forestry program
WSE - Wyoming State Engineer
WPSC - Wyoming Public Service Commission
WG&F - Wyoming Game and Fish Commission
WRC - Wyoming Recreation Commission
BLM - Bureau of Land Management
HCRS - Heritage Conservation and Recreation Service
BR - Bureau of Reclamation
FWS - Fish and Wildlife Service
GS - Geological Survey

Types of assistance 1/

T - Technical
F - Financial (grants or low interest loans)
R - Research
A - Authority on agency owned land

1/ Does not include any necessary permits.

Division of Agricultural Planning and Development

The Division of Agricultural Planning and Development has a responsibility to help the development of the agricultural sector of the state's economy. This is accomplished through conducting economic and statistical studies, planning for agricultural development, public involvement, information and education programs. These activities are done in coordination with various agencies of local, state and federal governments.

Wyoming Department of Economic Planning and Development

The Wyoming Department of Economic Planning and Development (DEPAD) is charged with the planning for and development of the physical and economic resources of the state. The department consists of the office of economic planning and development; administrators and councils of the division of water, industrial and mineral development; and the board of economic planning and development.

The division of water development is responsible for activities in connection with state financial assistance for water development projects. The department determines engineering and economic feasibility in order to base recommendations to the Wyoming Farm Loan Board for loan approval. Loans in an amount not to exceed $150,000 are available to court approved water districts with taxing authority, agencies of state and local government, persons, corporations and associations in Wyoming.

The division of industrial development is responsible for investigations and preparing plans and specifications for development in connection with any resource of the state, industry or business within the state and attracts new industry into the state. The division makes studies of soil and its uses, and makes studies to promote and protect the forest and range areas within the state.

The division of mineral development makes studies of all mineral resources, mines and mining, the exploration, development, conservation and production of oil and gas and other minerals, and prepares state legislation pertaining to resources of the state.

The chief of state planning is responsible for the comprehensive state plans for the physical and economic development of the state.

Wyoming State Forestry Division

The Wyoming State Forestry Division administers and manages all forested state lands, participates in cooperative state-federal forestry programs described earlier in this chapter, and provides assistance to private landowners. Major activities in the assistance to private landowners are for fire control, forest management, pest control and tree planting. This office cooperates with federal agencies in assisting in the planning of small watershed projects and resource conservation and development project measures.

Wyoming State Engineer

The State Engineer is responsible for the supervision of the state's water resources. Unreserved water may not legally be diverted from any natural source until a permit is obtained from the State Engineer. The Board of Control, with the State Engineer as president, adjudicates water rights and provides the field supervision of water rights and uses. The State Engineer is also responsible for the coordination of state water resources planning. The Wyoming Water Planning Program has developed a Framework Water Plan. The State Engineer is cooperating in development of this river basin cooperative study.

Wyoming Public Service Commission

There are three areas of water and related land resource development where the Public Service Commission has programs. They are: (1) rural, domestic and livestock water supply; (2) municipal and industrial water supply; and (3) rural power supply. The commission is charged by law with the regulation of all utilities in the State of Wyoming including water utilities and Rural Electric Associations. Individuals, companies or associations that intend to provide a utility, commodity or service to the public must first obtain a certificate of public convenience and necessity from the commission. The commission does not provide financial assistance.

Wyoming Game and Fish Department

The State Game and Fish Department is authorized to enter into cooperative agreements with federal agencies, corporations, associations, individuals and landowners for the development of state control of wildlife management and demonstration projects. Many public access areas for hunting and fishing have been established through this program. The department cooperates with USDA agencies in providing technical assistance to landowners who want to improve fish and wildlife habitat.

Wyoming Recreation Commission

The Wyoming Recreation Commission administers Big Sandy Recreation Area and Fort Bridger State Park. It also administers the Land and Water Conservation Fund through which financial assistance is provided to tax-based legal entities for the development of outdoor recreation areas and facilities. The Commission administers state-owned historic sites, monuments and markers. It also administers the Historical Preservation Fund and the Snowmobile Registration Act.

Wyoming Department of Environmental Quality

The Director of the Department of Environmental Quality is responsible for administering State programs involving land, air and water quality as required by the Wyoming Environmental Quality Act. The Division of Air Quality has as its primary goal the protection and enhancement of Wyoming's air resource. The major activities of the Air

Quality Division include a construction and operating permit program, a source inspection and surveillance program and an ambient and emissions monitoring program.

The Land Quality Division is responsible for State programs dealing with surface mining and reclamation. The Land Quality Division activities include the mining permit program, monitoring and surveillance of mining operations, a bonding program for mine reclamation and reclamation of lands affected by mining activities. The Department is also responsible for the coordination of all State programs concerned with solid waste management. The activities include administration of a permit program, on-site inspection and enforcement, hazardous material spills and training.

The Water Quality Division is responsible for protecting the quality of the State's waters. Division activities include water quality management planning, permit program to construct and operation of treatment facilities, a permit program dealing with discharge of wastes to waters of the state, water quality monitoring, municipal construction grants, operator training and certification and public water supply.

Special Purpose Districts

Districts are political subdivisions of the State of Wyoming. Several single purpose districts such as irrigation districts, drainage districts and flood control districts may be created under state law. Others such as conservation districts, watershed improvement districts and watershed conservancy districts can be multipurpose in nature. Each kind of district has unique powers and limits of power. Conservation districts promote the wise use of water and related land resources through the cooperative action of landowners. They secure technical assistance from the SCS or other agencies, help cooperators secure needed supplies and materials not readily available, and sometimes secure special equipment needed to apply conservation practices on the land. Watershed improvement districts are usually formed to provide local sponsorship, leadership, land rights and funds for watershed projects.

U.S. Department of Interior

Bureau of Land Management

BLM activities in the field are administered through District Offices in Worland, Casper, Rock Springs and Rawlins. The Districts are divided into Resource Areas with some having detached offices. The Rock Springs and Rawlins Districts each manage large acreages of public land within the Green River Basin.

BLM's primary responsibility is the conservation and development of our natural resources. Its basic programs include: lands; minerals; rangeland including wild horses and burros; forestry; watershed; recreation and wildlife habitat.

All other BLM activities support these resource programs. They include construction and maintenance of facilities, cadastral survey, fire protection, land records maintenance and reality service.

In 1976 with the passage of the Federal Land Policy and Management Act, also known as the Organic Act, some 3,000 outmoded laws were superceded which greatly streamlined the BLM's administrative policies. Under this Act federal lands are to be managed under multiple use and sustained yield principles protecting both the quality of the resources and environment. Land use planning and environmental assessment on federal land will be major responsibilities of the BLM in future years in implementing this Act.

Heritage Conservation and Recreation Service

The HCRS coordinates federal recreation programs and administers matching grants to states for state and local outdoor recreation planning, land acquisition and development projects. In addition, it can provide matching funds for the restoration and development of cultural resources. It can advise on a wide range of problems involved in state, county and regional outdoor recreation programs.

Bureau of Reclamation

This bureau has been very active in water development and conservation programs over the years. Though concerned primarily with large-scale water development programs involving multipurpose structural measures, it also administers a small projects loan program. This program allows organized entities such as irrigation districts and other agricultural water districts to obtain long-term financing for irrigation facility improvements. This would include such measures as canal lining, system reorganization and structure rehabilitation.

Fish and Wildlife Service

This agency carries out a continuing soil and moisture conservation program on the federal wildlife refuges and game ranges that it administers. Watershed needs on their acquired lands are fulfilled under their own programs while those problems on the public lands within the refuges are carried out cooperatively with the land administering agency.

Geological Survey

This agency through cooperative agreements with the states and other agencies has maintained a systematic collection of streamflow data at a vast number of stream gaging stations throughout the region. They also collect water use information, analyze groundwater conditions, maintain lake and reservoir stage-capacity gages and make available other hydrologic data that are vital to watershed programs.

Department of Defense

Army Corps of Engineers

The Army Corps of Engineers has been responsible for the general flood control programs throughout the United States since 1936, and is expected to continue investigations of flood and related water resource problems in the basin, and to assist local interests in emergency flood control action. The Corps is authorized to make a comprehensive investigation of flood problems in the Upper Colorado River Basin. The investigation is currently in an inactive status, but could be activated. In addition, the Corps is charged with the responsibility of regulating the discharge of dredge or fill material into waterways of the United States. In accordance with Section 404 of P.L. 92-500, a regulatory permit system has been implemented to protect waterways and wetlands from degradation associated with altering the character of these valuable resources. Bank protection measures and other channel, or wetland modifications should be coordinated with the Corps.

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Appendix Table A-1--Projected Acres, Yields and Production for Hay and Rangeland, Green River Basin, 1974

	Acres	Yield/Acre	Production	AUM Conversion	Total AUM's
		(Tons or AUM's)		(AUM's/Ton)	
Hay and Pastureland					
Alfalfa	29,960	1.98	59,320	3	177,960
Improved grass hay	42,900	1.20	51,480	3	154,440
Hay aftermath	42,900	.75 1/	32,175	--	32,175
Native hay	141,150	1.00	141,150	2	282,300
Hay aftermath	141,150	1.50	211,725	--	211,725
All pasture	118,500	3.00 2/	355,500	--	355,500
Subtotal	332,510	--	--	--	1,214,100
Small grain	3,590	--	--	--	--
Subtotal	336,100	--	--	--	--
Rangeland					
Private and state	732,420	.50	366,210	--	366,210
Forestland	572,870	.225	128,895	--	128,895
BLM, railroad and BR lands	10,498,890	.128	1,343,857	--	1,343,857
Subtotal	11,804,180	--	1,838,960	--	1,838,960
Total	--	--	--	--	3,053,060

1/ Revised down from the 1.5 shown in the Agricultural Base Working Paper.
2/ Revised up from the 1.95 shown in the Agricultural Base Working Paper.

Appendix Table A-2--Projected Acres, Yields and Production for Hay and Rangeland, Green River Basin, 1980

	Acres	Yield/Acre	Production	AUM Conversion	Total AUM's
			(Tons or AUM's)	(AUM's/Ton)	
Hay and Pastureland					
Alfalfa	31,805	2.24	71,245	3	213,735
Improved grass hay	48,350	1.40	67,690	3	203,070
Hay aftermath	48,350	.75	36,260	--	36,260
Native hay	140,000	1.10	154,000	2	308,000
Hay aftermath	140,000	1.50	210,000	--	210,000
All pasture	118,500	3.00	--	355,500	355,500
Subtotal	338,655	--	--	--	1,326,565
Small grain	3,600	--	--	--	--
Subtotal	342,255	--	--	--	--
Rangeland					
Private and state	728,120	.50	364,060	--	364,060
Forestland	572,870	.17	97,387	--	97,387
BLM, railroad and BR lands	10,498,890	.135	1,417,350	--	1,417,350
Subtotal	11,799,880	--	1,878,797	--	1,878,797
Total	--	--	--	--	3,205,362

Appendix Table A-3--Projected Acres, Yields and Production for Hay and Rangeland, Green River Basin, 2000

	Acres	Yield/Acre	Production	AUM Conversion	Total AUM's
			(Tons or AUM's)	(AUM's/Ton)	
Hay and Pastureland					
Alfalfa	37,130	2.65	98,395	3	295,185
Improved grass hay	54,000	2.00	108,000	3	324,000
Hay aftermath	54,000	.75	40,500	--	40,500
Native hay	146,120	1.30	189,955	2	379,910
Hay aftermath	146,120	1.50	219,180	--	219,180
All pasture	118,500	3.00	355,500	--	355,500
Subtotal	355,750	--	--	--	1,614,275
Small grain	3,600	--	--	--	--
Subtotal	359,350	--	--	--	--
Rangeland					
Private and state	711,030	.50	355,515	--	355,515
Forestland	572,870	.14	80,200	--	80,200
BLM, railroad and BR lands	10,498,890	.143	1,501,340	--	1,501,340
Subtotal	11,782,790	--	1,937,055	--	1,937,055
Total	--	--	--	--	3,551,330

Appendix Table A-4--Projected Acres, Yields and Production for Hay and Rangeland, Green River Basin, 2020

	Acres	Yield/Acre	Production	AUM Conversion	Total AUM's
		(Tons or AUM's)		(Aum's/Ton)	
Hay and Pastureland					
Alfalfa	40,950	3.3	135,135	3	405,405
Improved grass hay	60,000	2.5	150,000	3	450,000
Hay aftermath	60,000	.75	45,000	--	45,000
Native hay	148,290	1.30	192,775	2	385,550
Hay aftermath	148,290	1.50	222,435	--	222,435
All pasture	118,500	3.00	355,500	--	355,500
Subtotal	367,740	--	--	--	1,863,890
Small grain	3,600	--	--	--	--
Subtotal	371,340	--	--	--	--
Rangeland					
Private and state	699,046	.50	349,520	--	349,520
Forestland	572,870	.105	60,150	--	60,150
BLM, railroad and BR lands	10,498,890	.15	1,574,830	--	1,574,830
Subtotal	11,770,806	--	1,984,500	--	1,984,500
Total	--	--	--	--	3,848,390

Appendix Table A-5 Irrigated acres of hay and pastureland areas and grouped into land capability classes showing different levels of potential yield.

Map unit	Land capability classes by groups 1/	Acres by planning areas I	II	III	IV	V		Estimated potential yields: Alfalfa hay (tons)	Improved grass-hay (tons)	Improved native-hay (tons)	Improved pasture (AUM)	Improved native meadow pasture (AUM)	
BF-5 MC-10 MF-3	High - III_{c1}, III_{c2}, 3/ III_{c5}, III_{w61}, IV_{s1}, III_{e2}, III_{e3}, III_{e5}, III_{w63} IV_{c2}, III_{w1}	90,700	5,500	15,300	---	5,000		4.0 4/	3.0	1.5	5.0	3.0	34%
	2/ Medium - III_{w2}, IV_{e1}, IV_{e2}, IV_{e3}, IV_{e5}, IV_{e6}, IV_{e14}, IV_{e15}, IV_{s8}, IV_{s9}, IV_{s1}, IV_{s2}, IV_{s6}, IV_{s9}, IV_{w63}, IV_{ws6}, V_{s9}, VI_{s9}	56,400	10,200	19,900	---	2,200		2.5	2.0	1.0	3.5	2.0	27%
	Subtotal	147,100	15,700	35,200	---	7,200	205,200						
	Low - III_{w10}, III_{w11}, IV_{e10}, IV_{e12}, IV_{s10}, IV_{s11}, IV_{s12}, IV_{w2}, IV_{ws10}, IV_{ws11}, V_{w1}, V_{w64}, V_{w70}, VI_{ws6}, VI_{s11}, VI_{s70}, VI_{s11}, VI_{s71}, VI_{s10}, VI_{w70}	58,300	6,400	59,000	---	7,200		-	1.0	.75	2.0	1.0	39%
	Subtotal	58,300	6,400	59,000	---	7,200	130,900						
	Total	205,400	22,100	94,200	---	14,400	336,100						

1/ Land capability classes are used by the Soil Conservation Service to provide information on the suitability of soils for agricultural purposes. All of these soil capability classes given here occur in the Green River Basin for the various irrigated soils. The land capability classes were grouped into three broad levels of production potential - High, Medium and Low - for practical purposes. The number of acres for the three levels of production were determined by Planning Areas. A detailed description for each of these land capability classes is available in the State Office of the Soil Conservation Service.

2/ Not all is suitable for improvement. For the basin as a whole -- 60 percent is suitable for improvement.

3/ Land capability class III shown here comes from early interpretations prior to definitional changes.

4/ Damage by frost, hail, drought, insect infestation, and floods were not considered.

Appendix Table A-6 Recreation facilities, Green River Basin, Wyoming

National Forest Trail Facilities

Planning Area and County	Trailhead Facilities 1/	Trails (miles)
Planning Area I		
Lincoln County	0	42
Sublette County	5	725
Planning Area II		
Sublette County	1	90
Planning Area III		
Lincoln County	0	62
Planning Area IV	0	0
Planning Area V		
Carbon County	0	150
Totals	6	1,069

Campground Facilities

County	Number of Campgrounds	Total Acres	Annual Participation Capacity
Carbon	4	18	11,340
Lincoln	2	43	15,030
Sublette	18	235	158,454
Sweetwater	10	66	141,420
Uinta	2	27	45,750
Totals	36	389	371,994

Boating Facilities

County	Number of Boating Sites	Annual Participation Capacity 3/
Carbon	0	0
Lincoln	2	9,600
Sublette	4	48,270
Sweetwater	5	86,220
Uinta	0	0
Totals	11	144,090

Picnic Ground Facilities

County	Number of Picnic Grounds	Total Acres	PAOT 2/	Annual Participation Capacity 3/
Carbon	0	0	0	0
Lincoln	5	226	300	41,760
Sublette	4	22	85	14,300
Sweetwater	15	95	485	6,300
Uinta	2	43	217	43,560
Totals	26	386	1,087	105,920

1/ Trailhead facilities commonly consist of parking area, unloading facilities for horses, drinking water, and sanitation.
2/ PAOT - People at one time
3/ Annual Participation Capacity - PAOT x season x .60 (Refer to terminology in introduction).

Table A-7 Fishing capacities of streams by county and class of stream, 1974, Green River Basin, Wyoming

Stream Classes 1/ 3/

County	Class 1		Class 2		Class 3		Class 4		Class 5	
	Miles	Capacity 2/	Miles	Capacity 2/	Miles	Capacity 2/	Miles	Capacity 2/	Miles	Capacity 2/
Carbon	0.0	0.0	0.0	0.0	130.0	13,910.0	27.0	756.0	5.0	0.0
Lincoln	2.0	900.0	99.7	39,294.0	111.2	11,952.7	185.8	5,250.6	88.6	483.0
Sublette	93.0	46,500.0	90.4	24,288.6	712.4	78,125.9	744.3	32,870.8	59.0	42.0
Sweetwater	70.0	46,935.0	0.0	0.0	11.0	690.0	88.5	3,622.2	150.5	0.0
Uinta	0.0	0.0	0.0	0.0	87.0	14,623.0	153.0	3,704.2	75.5	1,127.6
Basin Totals	165.0	94,335.0	190.1	63,582.6	1,051.6	119,301.6	1,198.6	46,203.8	378.6	1,652.6

Basin Total Aggregation of Streams

County	All stream classes Miles	Capacity
Carbon	162.0	14,666.0
Lincoln	487.3	57,880.3
Sublette	1,699.1	181,827.3
Sweetwater	320.0	51,247.2
Uinta	315.5	19,454.8
Basin Totals	2,983.9	325,075.6

1/ Wyoming stream classification: Class 1 – premium trout waters; fisheries of national importance.
Class 2 – very good trout waters; fisheries of statewide importance.
Class 3 – important trout waters; fisheries of regional importance.
Class 4 – low production waters; fisheries frequently of local importance, but generally incapable of sustaining substantial fishing pressure.
Class 5 – very low production waters; often incapable of sustaining a fishery.

2/ Fishing capacity – minimum miles x present pressure x factor = fisherman day capacity.

3/ Data obtained from measuring on ERTS Satellite imagery indicator 6,240 miles of streams and intermittent channels.

Source of Information: Game and Fish Department, State of Wyoming, Cheyenne, Wyoming (June 26, 1974). Update March 1977 shows basin total of 2,953.5 miles.

Appendix Table A-8 Fishing capacities of lakes and reservoirs by county, 1974, Green River Basin, Wyoming

	Natural Alpine Lakes			Alpine Reservoirs			Natural Lowland Lakes			Lowland Reservoirs		
County	Number	Acreage	Capacity 1/	Number	Acreage	Capacity 2/	Number	Acreage	Capacity	Number	Acreage	Capacity
Carbon	1	14.0	15.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0
Lincoln	22	101.2	15.0	0	0.0	0.0	0	0.0	0.0	5	9,618.0	101,570
Sublette	598	21,454.6	187,218.4	7	5,027.3	147,059.0	1	312.5	15,937.5	8	2,528.3	8,960
Sweetwater	0	0.0	0.0	0	0.0	0.0	1	55.0	0.0	6	27,882.8	12,896
Teton	1	72.3	578.4	0	0.0	0.0	0	0.0	0.0	0	0.0	0
Uinta	3	14.0	13.0	2	527.5	374.0	0	0.0	0.0	3	49.0	113
Basin Totals	625	21,656.1	187,839.8	9	5,554.8	147,433.0	2	367.5	15,937.5	22	40,078.1	123,539

Basin Total Aggregation of Water Bodies

County	Number	Acreage	Capacity
Carbon	1	14.0	15.0
Lincoln	27	9,719.2	101,585.0
Sublette	614 3/	29,322.7	359,175.3
Sweetwater	7	27,938.4 3/	12,896.2
Teton	1	72.3	578.4
Uinta	8	590.5	500.4
Basin Totals	658	67,657.1	474,750.3

1/ Lake fishing capacity = total acres x pressure x factor.
2/ Reservoir fishing capacity = minimum habitat x pressure x factor = fisherman day capacity.
3/ Flaming Gorge Reservoir alone covers 48,200 acres in Sweetwater County, Wyoming; tables elsewhere in this report also show different figures; however, to maintain consistency with the state report from which these figures were derived, Game and Fish Department figures are used here.

Source of Information: Game and Fish Department, State of Wyoming, Cheyenne, Wyoming (June 26, 1974).

Stream esthetics, availability and productivity.

In determining the appropriate class, streams were first rated numerically 1 through 5 on esthetics, availability and productvity as follows:

Rating

ESTHETICS:

5-A stream of outstanding natural beauty usually of a unique type and possessing wilderness characteristics. Streams usually clean and clear

4-A stream comparable to 5 but lacking wilderness characteristics. Presence of human developments such as roads, farms or commercial establishments usually comprise the chief difference between 5 and 4.

3-A stream of considerable natural beauty but of a more common type than listed under 5 and 4. Clean and usually clear streams flowing through attractive agricultural areas of rough lands with picturesque scenery.

2-An area with average scenic or esthetic qualities. This type of stream is fairly common, usually clean waters and bordered by unabused land. Scenery while not unusual or outstanding is appealing.

1-A stream of fair esthetic qualities. Water is often turbid. The surrounding country has only mediocre scenic appeal and is of common occurrence. A lack of stream side cover is apparent. Mud banks are common and stream flows occasionally may become so low as to expose extensive mud flats and sand bars. Noxious domestic and industrial wastes may occur. This type of stream's primary esthetic appeal usually lies in the fact that it offers local people an opportunity to get outdoors near some water.

Rating

AVAILABILITY:

5-Accessibility to fishing waters by road is satisfactory for modern cars (not excessive such as a highway bordering the stream). Stream access in terms of posting and availability to fisherman use very good. Camping and lodging opportunities available, stream floatable.

4-Vehicular access relatively good (may be excessive as described in 5), posting not extensive, stream bank cover not restrictive to fisherman utilization. Stream not floatable.

3-Accessible road or trail is fit or appropriate for jeep, horseback or afoot. Posting not considered as an important restrictive problem.

2-Accessibility is often difficult or posting so extensive as to seriously restrict fisherman access.

1-Accessibility is inadequate as natural or man-made restrictions cause fisherman utilization to be almost impossible.

Rating

PRODUCTIVITY:

5-Supports high fish populations in good condition of one or more species of the better cold-water game fish and/or the fishing water is large enough to accommodate considerable use and can withstand heavy to moderate fishing pressure. Natural propagation generally maintains the population although some stocking may be required or has been required in the past.

4-Supports a moderate fish population of one or more better game fish species. Fishing waters are moderate in size, however, productivity is high and water can withstand much fishing pressure.

3-The fishing waters are small, however, productivity is good and can withstand heavy to moderate fishing pressure; or fishing waters are large but productivity is low and hatchery stocking is required to maintain fishing success.

2-The fishing waters are small and/or cannot withstand much fishing pressure due to lack of cover, short growing season, shallow water, etc.

1-Supports low populations of game species. Waters can be either large or small but are of such a nature that a successful long-term fishery cannot be maintained by either natural or artificial means.

Once the above determinations were made, the criteria were weighted by multiplying esthetics by 1, availability by 2 and productivity by 4. Using the sum of the weighted values the appropriate class was defined by the following ranges:

Class 1 31-35; Class 2 25-30; Class 3 18-24; Class 4 11-17; Class 5 7-10.